THE SURVEY

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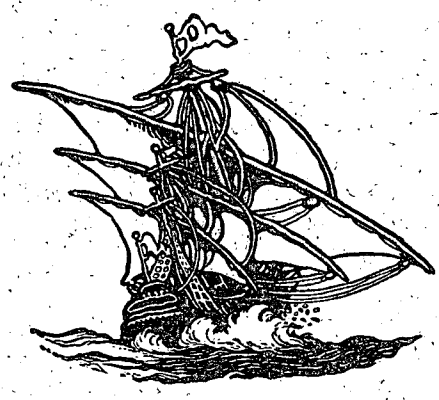

Giant Power

Forecasting social changes as sweeping as those ushered in by the Industrial Revolution

Interviews with

Herbert Hoover
By William Hard

Henry Ford
By Paul U. Kellogg

Articles by

Gov. Gifford Pinchot
Philip Cabot
Morris L. Cooke
H. G. Butler
Joseph Hyde Pratt

Gov. Alfred E. Smith
Robert W. Bruère
Samuel Gompers
Marion M. Jackson
Martha Bensley Bruère

Sir Adam Beck
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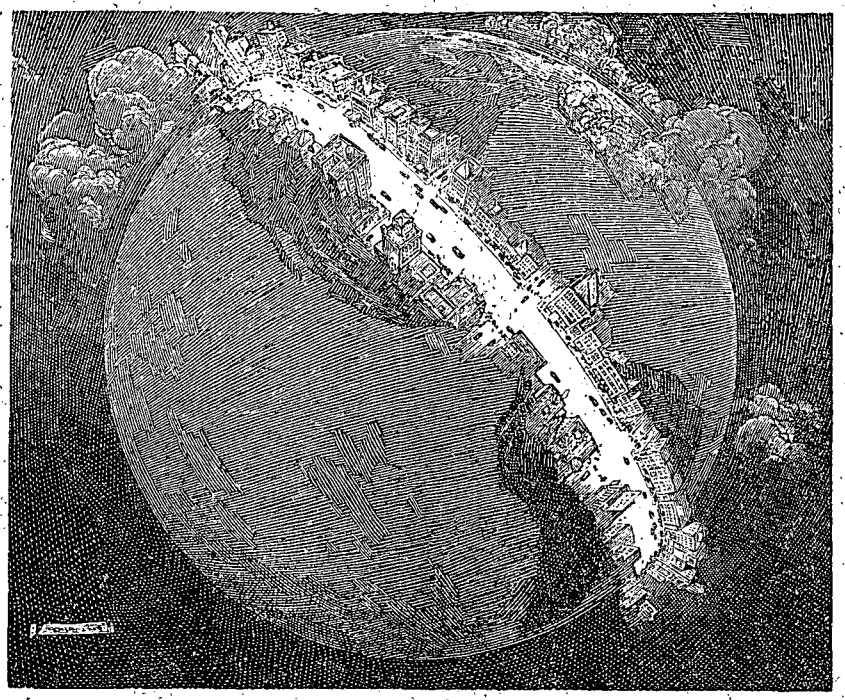

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Mexico—A Promise

The Editors of The Survey announce for May

a special number of Survey Graphic on our neighbors to the south of us; presenting materials gathered by Frank Tannenbaum, who made a special trip to Mexico to execute this commission for Survey Associates. This number will contain a series of articles largely written by Mexicans themselves and voicing the newer aspirations of the Mexican people. It will contribute to an understanding of the fundamental significance of the Mexican struggle of which this winter's rebellion of military leaders is but the latest chapter. Its graphic features will be drawn from the most distinctive art of the New Hemisphere.

AMONG THE CONTRIBUTORS

GENERAL PLUTARCO ELÍAS CALLES, presidential candidate and next to Obregon, the sturdiest figure in contemporary Mexico—*The Meaning of a Hundred Years of Revolution in Mexico*

CARLTON BEALS, author of Mexico—an Interpretation, and the keenest foreign student of Mexican problems writing today—*The Obregon Regime*

FELIPE CARILLO, the recently murdered governor of Yucatan, and the most beloved and picturesque figure in native America—*The New Yucatan*

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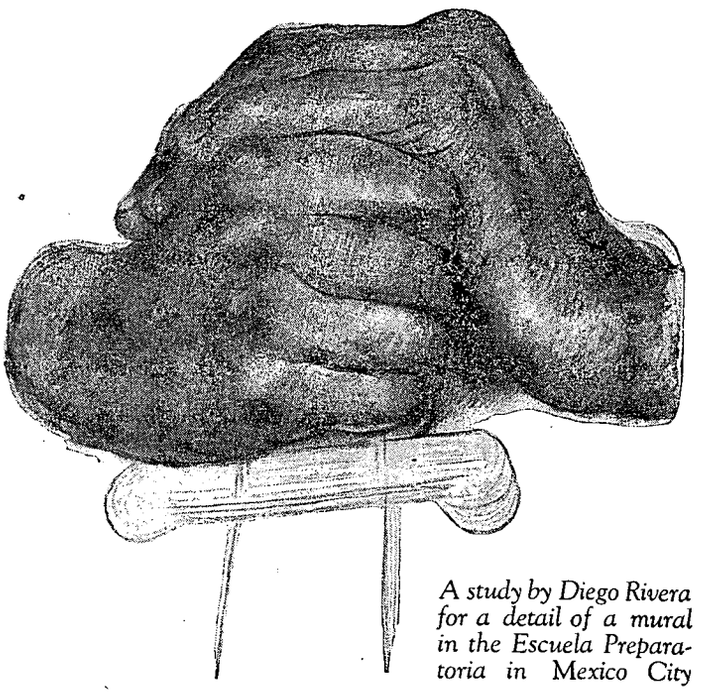

A study by Diego Rivera for a detail of a mural in the Escuela Preparatoria in Mexico City

EMANUEL GAMIO, head of the Department of Anthropology and Mexico's greatest scientist—*The New Conquest*

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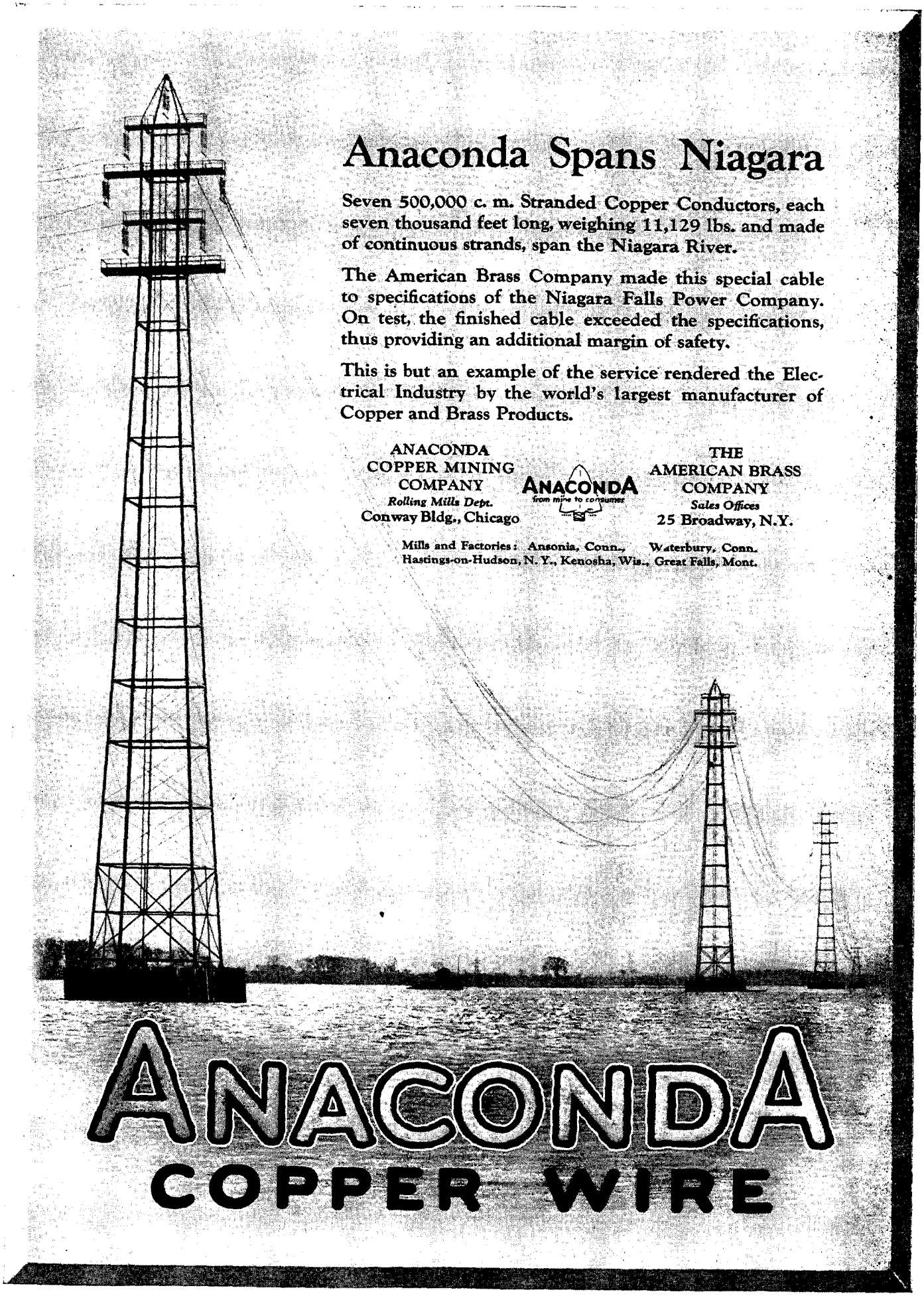
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THE SURVEY

Graphic Number

Vol. LI, No. 11 March 1, 1924

CONTENTS

PANDORA'S BOX . . . . . *Robert W. Bruère* 557
Drawings by Hendrik Willem Van Loon
GIANT POWER . . . *Governor Gifford Pinchot* 561
BY-PRODUCT OVENS, *Drawings by Joseph Stella* 563
OUR FEDERAL POWER POLICY . *Philip P. Wells* 569
STAKE OF THE PUBLIC, *Gov. Alfred E. Smith* 574
NEGOTIATIONS FOR GIANT POWER: An Interview with Herbert Hoover . . *William Hard* 577
NATIONAL ELECTRIC HIGHWAYS, *Philip Cabot* 581
ONTARIO'S EXPERIENCE . . . *Sir Adam Beck* 584
FOLLOWING THE HYDRO, *Martha Bensley Bruère* 591
WORK PORTRAITS . . . . *by Lewis W. Hine* 595
THE LONG LOOK AHEAD . . *Morris L. Cooke* 600
Map by George H. Ashley
POOLS OF POWER . . . . . *H. G. Butler* 605
PROJECT MAP OF SUPERPOWER LINES . . . 608
Based on maps by Bacon and Frank G. Baum
IN THE SOUTHERN APPALACHIANS . . . . . *Joseph Hyde Pratt* 611
Map reproduced from Electrical World
IDLE SLAVES OF THE SOUTH . *Marion Jackson* 613
Woodcut by J. J. Lankes
AERIAL MAPS 615
APPALACHIAN POWER . . . *Benton MacKaye* 618
FOREST AND STREAM . . . *George D. Pratt* 620
POWER AND CULTURE . . . *Joseph K. Hart* 625
SOME TOOLS OF THE TRADE . *Lewis W. Hine* 629
POWER AND LABOR . . . . *Samuel Gompers* 633
THE ENGINEER'S PLACE . . . *Gerard Swope* 635
A BIG MAN WITH A LITTLE RIVER: An Interview with Henry Ford . . . *Paul U. Kellogg* 637
EDITORIALS 643
SOCIAL STUDIES . . . . . *Joseph K. Hart* 644

The Gist of It

THIS sheaf of articles, unexampled in range and contents, represents a year's scouting on the borderland between experience and prophecy. At the outset we wish to express our appreciation to the public officials, engineers, social workers, journalists, bankers, manufacturers, employers, labor leaders, educators, air-men, lawyers, conservationists and others collaborating.

YESTERDAY national forester; today chief executive of a commonwealth called in to settle the anthracite strike, Governor Pinchot sets the keynote for our Special Number (p. 561). He tells us what is meant by Giant Power. Back of what he says lies the story of a conservationist's quest in the hills where trees grow and waters slide and carbon lies in deep seams for the energy needed by an industrial civilization.

HOW for better or worse Giant Power concerns every social movement of our generation, is brought out by Mr. Bruère, associate editor and director of the Bureau of Industrial Research, who conceived this Number and organized our joint work (p. 557).

WHILE the sources of giant power are, simply enough, coal and falling water, their use is caught up in an intricate meshwork of law, regulation and precedent. Who is to control? How (thanks to the conservationists) we started with a clean slate, in the Federal Water Power Act, and what snags are still in the way, is set forth by Mr. Wells, the former chief law officer of the U. S. Reclamation Service, now deputy attorney general of Pennsylvania (p. 569). The governor of the state which has the largest supply of coal (Mr. Pinchot, p. 561) stands for state action articulated with this federal system; the governor of the state which has the largest single supply of water power (Mr. Smith, p. 574) stands for retaining in the hands of a state authority the primary control of its natural resources. The Secretary of Commerce, our ranking engineer, interprets with an engineer's vision the possibilities of interstate action as developed by the Colorado River Commission of which he was chairman (p. 577).

BACK of this question of jurisdiction is the larger one of possession. Mr. Smith (p. 574) stands for public ownership. Mr. Cabot (p. 581), investment banker and public utility operator, speaks for the expansion of private development, already under way, and for a simplified regulation to forefend against the abuses and weakness in the relations between the railroads and conflicting governmental bodies. In contrast Sir Adam Beck (p. 584) speaks for public development, now in full swing in Ontario, where 300 municipalities cooperate through a provincial commission in generating and distributing electric current.

THIS number more than forecasts the changes that are upon us: it describes them, for in the coal-less regions of California and Ontario we have evidence of what hydro-development is going to mean to farm, village and city. Witness Mrs. Bruère's racy narrative of what housewives and farmers have to say (p. 591). The interest of the small consumer and the outlying countryside are especially reckoned with by the Director of the Pennsylvania Giant Power Survey, which is not only the first comprehensive inventory of the fuel and power resources of a state, but has thrown its emphasis on social considerations (p. 601). Mr. Cooke was director of the Department of Public Works of Philadelphia under Blankenburg. Mr. Butler tells of the interconnecting systems on the Pacific Coast which exceed anything in the eastern states, in length, capacity and service to town and country (p. 605). He was power administrator of California during the war and, as consulting engineer, has been identified with large-scale private projects. The crystallization of power systems in the South is described by the director of the North Carolina Geological and Economic Survey, Joseph Hyde Pratt (p. 611).

THE engineers heard, we turn to other spokesmen who are roused to the tremendous social bearings of the impending technical revolution—to the attorney for the Municipal League of Georgia, Mr. Jackson (p. 613) with his rousing plea to the people south of the Mason and Dixon line to safeguard their heritage,—to the forester, now enlisted in a regional project for planning the re-development of the Appalachian mountain territory, Mr. MacKaye, earlier a specialist in colonization of the U. S. Department of Labor (p. 618); to the former Conservation Commissioner of New York, George D. Pratt (p. 620) who reveals the urgent relation between the promise held out by water power and our spendthrift waste of timber lands; —to the educator, Professor Hart (p. 625), associate editor of the Survey, who relates the new revolution to the springs of a people's culture and comprehends the whole struggle of civilization in his searching analysis;—to the industrial executive, (p. 635) Mr. Swope, president of the General Electric Company, who evaluates the contribution of the engineer when he turns from mechanical discoveries to social invention;—to the labor leader (p. 633) Mr. Gompers, president of the A. F. of L., who appraises the stake of the workers in an epoch of change;—to the inventor, (p. 637) Mr. Ford who would apply business organization to a watershed, interlocking farm and factory work.

INTO this new drama of Giant Power enter a new cast of characters—the men who harness electrons and drive them along wires. These Mr. Hine (p. 595) shows us from corporation president to the lineman who climbs the poles. Into this drama comes also new scenery—the world from the air. The scene painters are the aerial photographers who show us up—from above, (p. 615); whose maps of stream and forest, farm land and town look like so much patch work—like the blocks of experience and prophecy which, if you will, make up this special number; with the crooked tracings of old private property lines and public rights of way, shot across as the crow flies with the projected swift thoroughfares of energy.

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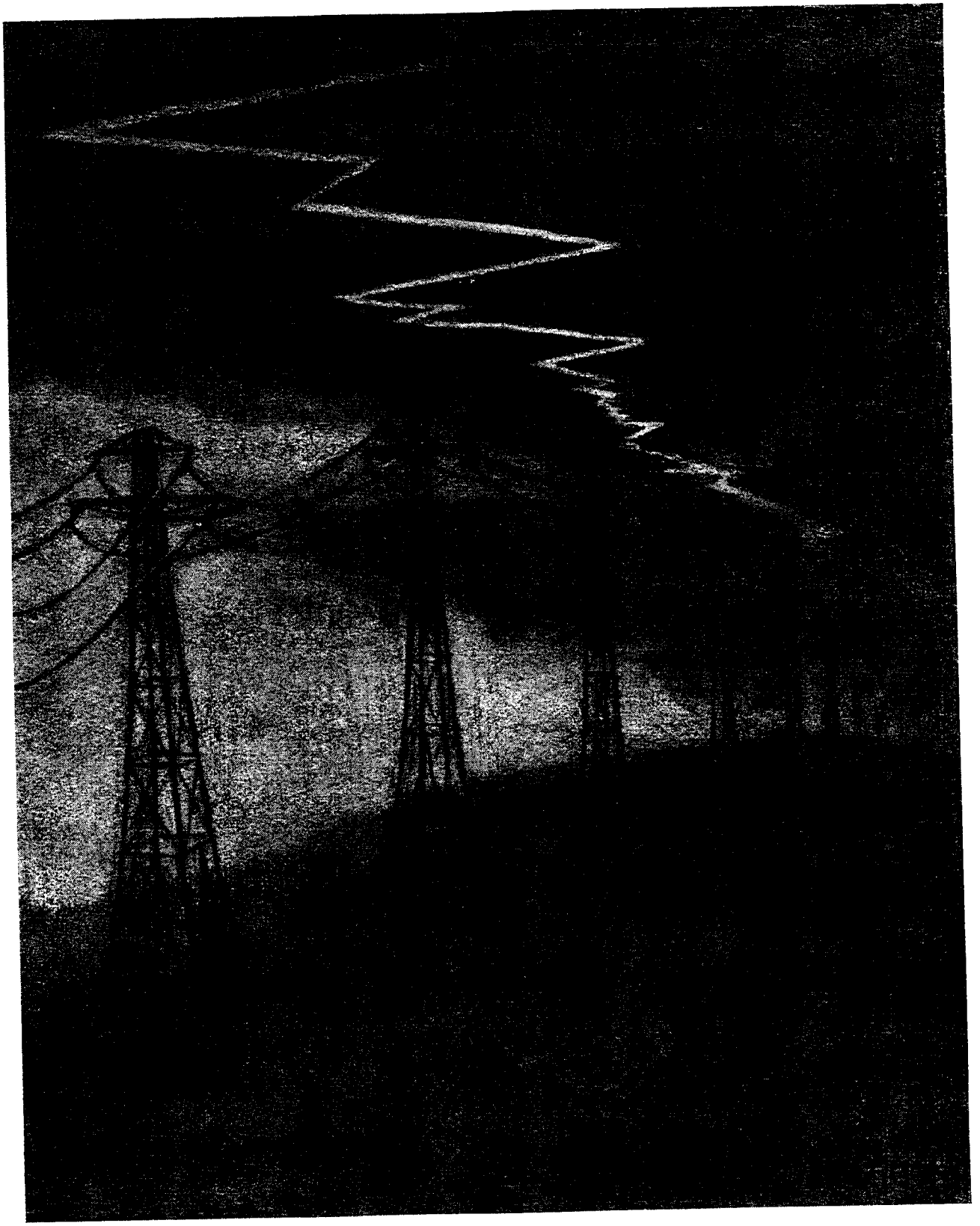

Drawn by Martha Bensley Bruère

"HIGH TENSION TRANSMISSION TOWERS MARCH IN INDIAN FILE BEARING THE THUNDERBOLT CAPTIVE ON THEIR SHOULDERS"

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THE SURVEY
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MARCH 1, 1924

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Pandora's Box

By ROBERT W. BRUÈRE

Drawings by HENDRIK WILLEM VAN LOON

WE are on the threshold of a technical revolution. Through high voltage transmission lines, the mechanical engineers are harnessing the rivers and the coal seams to electrical generators having the capacity of hundreds of thousands of horses. They are gathering the stored energy of the sun into reservoirs of power that compare with the isolated steam engine as a mobilized nation compares with the minute man. The forces for good and evil latent in Giant Power surpass those ushered in when Watt's engine harnessed coal to the looms of England.

Who that has faced the evils of the Industrial Revolution in smoke-blackened slums—the plagues of infant mortality and tuberculosis in crowded tenements, of brutalizing drudgery in sweatshop, mine and isolated farm—has not asked what the world might have been if the social sciences had grown up and kept pace with the mechanical sciences, if from the start there had been a working alliance between the organizers of industry and the social professions? The characteristic hygienic and educational problems of our generation are due not so much to the mechanical inventions of the Eighteenth century as to the fact that human engineering was then non-existent. The dominant purpose of the mechanical engineer in the service of the captains of industry has been the increase of material wealth; the primary concern of social worker and educator, of health builder and civic leader, of industrial hygienist and labor organizer, of the human engineer by whatever name he is called, is the conservation and enrichment of life. From the early day of ruthless exploitation in mine, mill and factory, the mechanical engineer has waged his "war against nature" as the military commander wages battle; he has discounted any immediate sacrifice of life to attain his technical objective, assuming that from his mastery of the earth's physical resources the greatest good would ultimately flow to the greatest number. The history of the Nineteenth century, culminating in the World War, is in one of its main strands the history of this "practical" point of view, slowly modified by the piecemeal establishment of social standards.

HOW the steam engine increased the wealth of the earth, built gargantuan factories, established international highways, forged the framework of a world-wide economic organization is a story as familiar to our generation as the story of Prometheus, the Fire-bringer, was to the Greeks. Equally familiar is the story of the evils that followed in its train like the plagues from Pandora's box. Pandora was Prometheus' innocent Eve. She, like our Eighteenth century ancestors, loosed sorrow into the world because she did not know what her box contained. We have their experience to guide us. Have we the wisdom so to use it that the new and greater technical revolution now upon us shall serve human wellbeing, shall overcome rather than intensify the evils of the old?

THE distinctive achievement of the human engineers has been their gradual establishment of standards by which the essential human worth of inventions and discoveries, and of their industrial and political administration, may be tested. These standards rest upon the assumption that the measure of a successful civilization is not primarily accumulated material wealth, but human wellbeing; that in bringing the individual to fulfillment and shaping individual lives into fruitful and harmonious relationships, men share in the infinite creative process. Whether the new technical revolution, heralded by Giant Power, shall proceed without the evil concomitants of its predecessor depends very largely upon the resoluteness of

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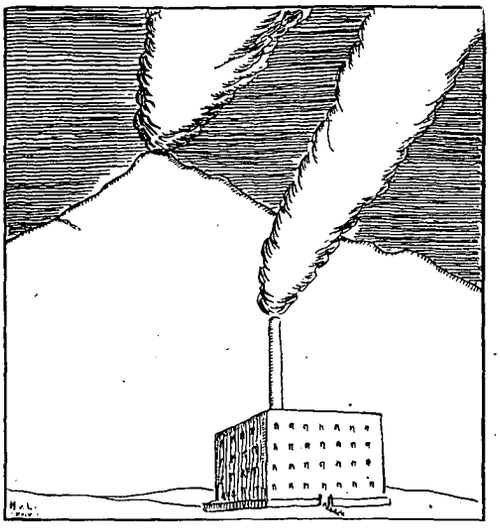
the social professions in winning acceptance for these standards of health, education and spiritual freedom as basic; their capacity to achieve a working alliance with the mechanical engineers such as proved so effective in the relatively small matter of the long day in steel.

The problem bristles with difficulties, not only because of the almost irresistible domination of industrial developments by our headlong acquisitive instinct, but also because, being of recent origin and correspondingly timid, the human engineers have worked out no large plans for the distribution of population and the spiritual enrichment of community life comparable to those which the mechanical engineers have developed for the production and distribution of mechanical energy. They have been content to be camp followers rather than patriots in their own right, Red Cross workers to the captains of industry rather than co-equals in community building.

Through the development of the electrical industry, the mechanical engineers are reconstructing the material foundations of America; the human engineers are hardly aware that a new technical revolution is on.

And the few that are rest under the romantic illusion that large scale electrical development means only the harnessing of our streams; they have yet to realize that for the greater part of industrial America, giant electrical power must be coal power. Even the recent U. S. Coal Commission failed to recognize the fact that most of the fuel and power questions presented to it depend for their answer upon the more economical utilization of coal and the conversion of its latent energy into electricity at or near the mines. Moreover, as with workmen's compensation and public health, the control of Giant Power, which is essentially monopolistic in character, involves questions of public policy in reference to business enterprise that are charged with highly explosive prejudices. The feeling of theological fundamentalists and modernists is brotherliness itself compared with the feeling which advocates of private and public development of the electrical utilities entertain toward one another. Standing as he does on neutral ground with respect to these political issues, the human engineer is in a peculiarly advantageous position to demand all the facts and to appraise them dispassionately in the light of established standards of civilized life. But facts without concrete plans and the capacity to use them are dust in the wind. Social engineers face the new technical revolution almost as naively as the philanthropists of the Eighteenth century faced the old.

AS April approaches, we again face the possibility, not yet altogether warded off, of a nationwide bituminous coal strike. The economic and social implications of Giant Power are only the latest phase of the cumulative problems arising out of the large scale utilization of coal. This Giant Power Number of Survey Graphic becomes then a logical sequel to the Coal Number published on the eve of the great strike of April, 1922. It was a conscious reflection of the current public interest in coal that gave to the Coal Number



Competitors in waste

the sub-title, *The Coal Strike—What Lies Back of It?* instead of, let us say, *The Coal Industry—Its Service to American Life.* The recurrence of strikes in the coal fields, coal shortages, the sky-rocketing price of domestic fuel, the demoralizing effect of instability in the coal industry upon manufacture, transportation, and our entire domestic economy, have made coal strikes matters of peculiar public anxiety. It is characteristic of our emotional habit of approaching such problems that public opinion as expressed in the press and legislative assemblies should generally cry out against the wicked greed of the coal "barons," the impudent arrogance of the unionized miners, or in obeisance to impartial fair-mindedness, against both. The fact is that few groups of business men have rendered a more fundamental public service under more difficult conditions than the reviled coal operators; and there is wide consensus of judgment among students of labor that the miners' union has contributed in exceptional ways to industrial peace and the health of our social fabric. Among other things, the miners have maintained through their union what is probably our greatest single school of Americanization and self-government. That the coal operators and miners should be primarily interested in profits and wages does not differentiate them from business men and wage earners in general. It is our peculiar dependence upon the coal industry that makes our condemnation of its shortcomings abnormally harsh.

To as great an extent as the public they serve, the men within the industry, owners and employes alike, suffer from the persistence of an outworn technical equipment and our general American habit of planless and wasteful exploitation of our uniquely abundant natural resources. Largely because we possess the richest coal fields—seventy per cent of all workable coal lies in the United States—we have built up the highest economic standard of living in the world. The unrest in the coal industry is part and parcel of our general social unrest and due in the main to the same cause. We have not only established a relatively high economic standard, but we have also acquired in the process the invigorating habit of demanding a steady and limitless advancement of that standard.

"My God," cried an alarmed operator to the miners' spokesman in a wage negotiation, "what is your limit?"

"Our limit?" the miner volleyed, "Your limit—no limit!"

Having spent our inheritance like prodigals, we are finding it increasingly difficult to satisfy this robust demand. In Giant Power and the new technical equipment which its development exacts, the mechanical engineers are offering us a possible release from our predicament.

THE coal industry is not only basic to all machine industry, but it is also socially typical of what Patrick Geddes describes as our passing paleotechnic age. It is preeminently the industry of contrasts, of concurrent wealth, poverty and waste. The traditional technique of mining has put at least one ton of coal beyond recovery for every ton

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brought to the surface. While high grade coal was abundant and easily accessible, this fifty per cent waste, like the waste of our forests, was not felt. It was the coal that got to the stoves and boilers that counted.

A nation's capacity for commodity production rises in approximately direct ratio to the amount of mechanical energy placed at the disposal of its individual workmen. The rapid increase of coal production during the last century gave American industry foremost rank in production per man. The same rule holds for wages. Mechanical horsepower per workman in England is about half that in the United States and British wages are about half of American wages; in Japan both horsepower per man and wages are about one-fourth of those in the United States.

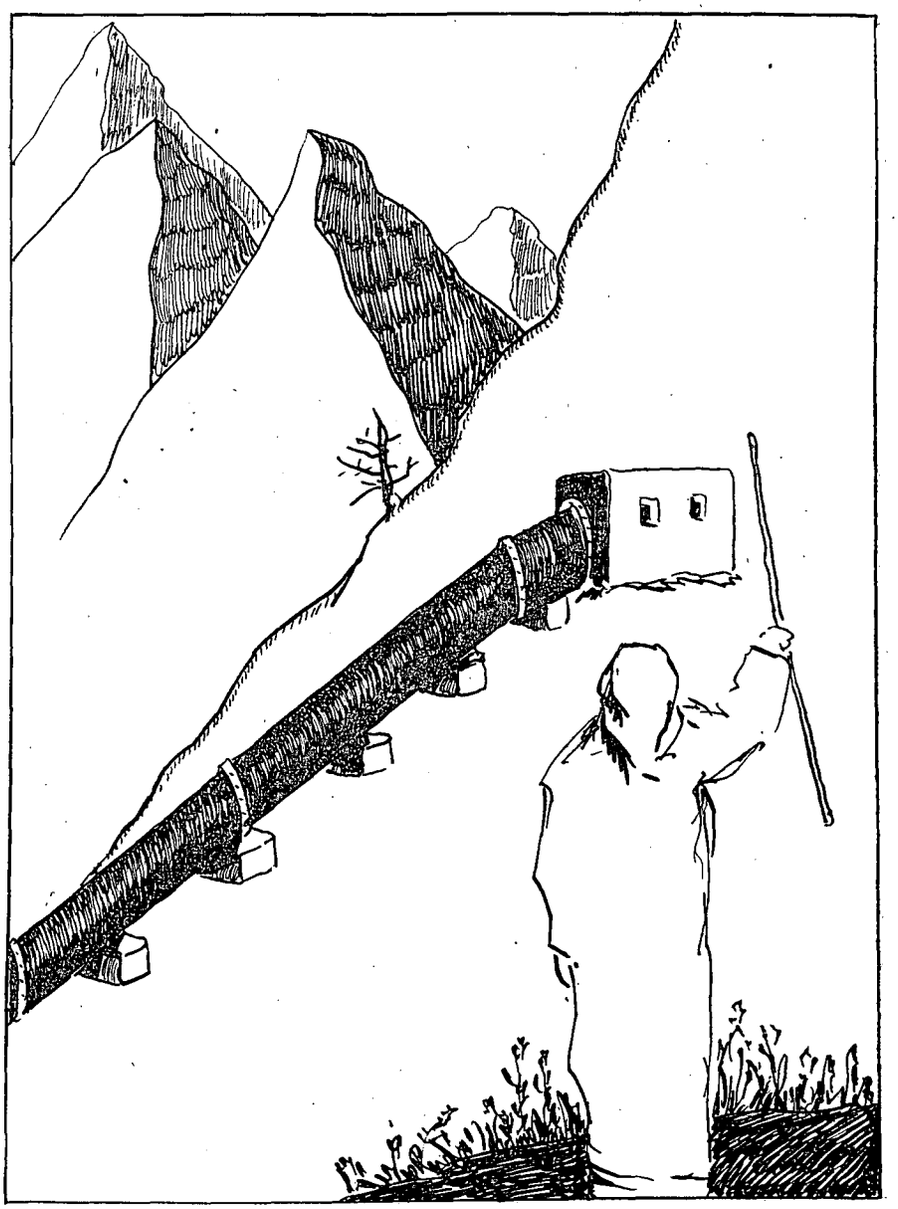
A disproportionate increase in the cost of mechanical energy would rapidly impair America's differential advantage and put the economic brakes on the advancing standard of living. At this point, waste whether in the production of raw materials or in the processes of manufacture, begins to count, not theoretically only, but actually and immediately. This point both our mining industry and also our steam railroads and all industries which derive their mechanical energy from the burning of raw coal have reached. It is commonly said that the disease of the coal industry is over-development—too many mines, too many miners, with consequent irregularity of markets, speculative prices, and excessive intermittency of employment. It would be truer to say that the disease of the coal industry, whose contagion all other industries so quickly catch, is under-utilization of the energy of coal and the gross waste of its commodity values—the tar and ammonia, sources of thousands of useful things, and the light oils which go up in smoke to the squandered value of billions of dollars. This waste is due to our outworn machine equipment, as inadequate to the aspirations of contemporary life as the mill wheel and the stage coach were to the Nineteenth century. Until coal is converted into electricity at or near the mines, and its by-products salvaged, strikes, coal shortages, unstable markets, high prices and intermittent employment will continue as "normal" characteristics of the industry.

TWO concrete examples may lift the veil from these technical mysteries. We produce some five hundred million tons of bituminous coal annually in addition to eighty millions tons of anthracite that get to the market. More than one-third of all the freight the railroads carry is coal and railroad engines burn about one-third of our annual production—a considerable percentage of it while they are idling in roundhouses or on sidings waiting to get into action. The foremost of our electrical authorities who has made his knowledge available to laymen is Frank G. Baum.*

*Author of the *Atlas of the U. S. A. Electric Power Industry.*

On the basis of a thoroughgoing statistical analysis, he finds that the cost of railroad steam power is approximately 0.1 cent per ton mile, of electrical power 0.05 cent. "If all the railways of the United States were electrified and coal used to provide the electrical power, there would be a saving per year of approximately 85,000,000 tons, or 50 per cent of the 170,000,000 tons used by the railways." He finds that about 70,000 miles, or approximately 30 per cent of our total railway mileage, have sufficient traffic density to warrant immediate electrification. He finds that complete railroad electrification under a giant power system would produce an annual saving in coal and the costs incidental to its firing of $800,000,000.

MANY estimates have been made of the commodity values wasted in the smoke given off in the ordinary firing of raw coal, to say nothing of the damage wrought by coal smudge. Gilbert and Pogue, in their study of America's Power Resources made originally for the Smithsonian Institution, figured these losses on the basis of normal values in 1915 at $1,000,000,000, having regard to our entire



If Moses should smite the black rock?

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annual production of 500,000,000 tons of bituminous coal, to which they added another $1,000,000,000 chargeable to needless transportation and mining. Many experts have decried these estimates as extravagant. Coal was too cheap, they said, to warrant the installation of the costly ovens required to extract the by-products from coal. Besides, they protested, there would be no market for them if they were salvaged. There was the old terrible fear of over-production; as if, given an intelligent system of distribution and consumption, the world could not use all the energy and other commodity values the world could produce.

Today, the number of coal by-product ovens is rapidly increasing, but with few exceptions they are still divorced from the steam boilers under which most of our coal is burned. In the whole state of Pennsylvania, our greatest coal producing and consuming state, the director of Pennsylvania's Giant Power Survey assures us that not one by-product oven is operated as an integral part of a power plant. Coal is "too cheap." But already the experience of the by-product industry proves that the estimates of Gilbert and Pogue were conservative.

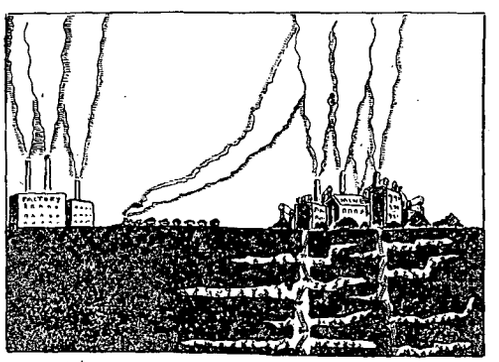
KNOWING in advance what is in Pandora's box, shall we let the lid be lifted—laissez-faire, let her rip—or shall we, by taking counsel together, seek to win the nascent blessings of the new technical revolution without turning loose its potential plagues?

THE general bearing of such colossal wastes on wage disputes in the coal fields, on industrial unrest everywhere, and on our national standard of living is obvious. Their immediate bearing upon Giant Power is that it is only through the full development of the coal by-product industry as an ally of electrification that electricity from coal can be supplied as cheaply as hydro-electricity at favorable locations like Niagara Falls. The fact that throughout the major industrial and agricultural sections of the United States, Giant Power must primarily be coal-derived power cannot be overstressed.

It is reminiscent of colonial days, when power meant principally the power of streams flowing over water wheels, that our one federal power statute should be the Water Power Act. Navigable streams and the energy they are capable of generating traditionally belong to the category of public utilities; the coal mines though they are more important to transportation than streams and though they are in our day the primary sources of mechanical energy remain by historical accident outside of this category. This is one reason why the public imagination has been so greatly intrigued by the romantic possibilities of White Coal. The first of the modern electrical generators were, indeed, built at Niagara and on the precipitous mountain streams of California. When there is a firm year-round flow of a large volume of water such as Niagara's, hydro-electricity has great economic advantages. Great streams will continue to flow while rains fall, and once they are harnessed they work automatically. But if all the mechanically available water power in the United States, as calculated by the Geological Survey, were developed, the resultant energy would be only a fraction of the energy we already derive from coal. The late Charles P. Steinmetz, in his article published in the Coal number of Survey Graphic, showed that "if every raindrop which falls anywhere in the United States were collected and all the power which it could give on its travel down to the sea" were converted into mechanical energy, it would amount to "just about the total which we get out of our present consumption of coal for all purposes." Of the undeveloped water power in the United States, more than one-half is in the four states of Washington, Oregon, Idaho and Montana; a trifle more than one per cent is in Pennsylvania; less than one per cent in New York and Massachusetts combined. The total energy which now runs to waste in our unharnessed streams, highly important as it is, is yet less by far than the waste incident to our burning of raw coal under steam boilers.

Unless and until some hitherto undiscovered source of mechanical energy is found, or until means are devised for the large scale storage of direct solar energy, the progress of the new technical revolution will continue to depend upon the conversion into electricity of the solar energy stored in coal.

THE immediate objective of Giant Power is the conversion of all our primary energy resources into electricity and their pooling into regional systems which will then be integrated into a nation wide federation of systems. There is abundant evidence that our commercially available energy resources—the mechanical energy at the disposal of the individual workman—are in process of incalculable increase. Large power plants already get from two to three times as much effective mechanical energy out of a ton of coal as small plants; a mercury engine has been invented that promises to double this efficiency. There is unfortunately no parallel evidence of increased social planning and foresight. The general tendency today is toward a socially blind intensification of the crowding, speeding-up, and intergroup friction which characterized the steam revolution. At one of the first great electricity generating plants built at the mine-mouth in the bituminous coal fields, one may see power houses and machinery embodying the last word in mechanical engineering technique side by side with a mining village whose most conspicuous architectural features are the mine-guard with revolver at his hip, and a high picket fence, picket placed flush with picket, designed to insulate the company men from the influence of the miners' union. The homes in this camp are hundreds of years removed from that possible home of convenience, comfort and beauty which shines so alluringly from the electrical advertisements. The magnificent stream of power which flows from this (*Continued on page* 646)



Giant Power must primarily be coal-derived power

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Giant Power

By GIFFORD PINCHOT

Governor of the Commonwealth of Pennsylvania

AS in the story books of our childhood a giant—Giant Power this time—is about to do wondrous things for the human race. From the power field perhaps more than from any other quarter we can expect in the near future the most substantial aid in raising the standard of living, in eliminating the physical drudgery of life, and in winning the age-long struggle against poverty.

For weeks and months after our entry into the Great War the effectiveness which we ultimately developed was held in check by what someone has called the distance disease—the battle-front was three thousand miles away instead of at the far end of a telephone wire. Principally because our utilities—even the largest and most far reaching of them—have grown up out of small and isolated beginnings we have been slow to recognize that distance is a rapidly disappearing factor in public utility development. In high tension transmission of electric current distance is as unimportant and state lines as meaningless as in the pumping of oil from the Oklahoma fields to the Atlantic seaboard. Giant power now seeks a new form of cooperation among these vast enterprises in which the distance factor will be accorded only the importance which modern science and engineering gives it.

Giant Power is a term coined to suggest the realization of far-reaching social objectives through a vaulting engineering technique. We conceive Giant Power as a social force unshackling our people for the Great Adventure. Giant Power is also the equivalent of the sum total of controlled and interconnected mechanical energy within an area the limits of which are fixed—not arbitrarily as by state lines or by the historical development of some public or private enterprise—but by technical considerations. In a way we have always had such pools of power—every independent power plant with its distribution wires constituted such a system. But now that the distance factor is all but removed, these interconnected areas spread out wondrously—their radial power lines extending hundreds of miles in every direction from common generating centers.

Giant Power means giving to every producer of current an opportunity to add to a common stock and to every user an opportunity to draw therefrom. Giant Power means the practice on the broadest possible scale of every possible economy, such as the pooling of standby facilities and the elimination of every waste, such as that due to a low power factor. But Giant Power also means the education of the public to the point where it can intelligently and fully cooperate with public and private enterprise in these objectives. We approach the time when the load factor of a community may be made to mean more than the interest rate or the cost of living index.

The Pennsylvania Legislature at the session held during the Spring of 1923 made an appropriation at my recommendation for a Giant Power Survey which in the words of the Act is to study

> the water and fuel resources available for Pennsylvania and . . . the most practicable means for their full utilization for power development and other related uses; to recommend such policy with respect to the generation and distribution of electric energy as will secure for the industries, railroads, farms and homes of the Commonwealth an abundant and cheap supply of electric current for industrial, transportation, agricultural and domestic use; the practicability of the establishment of giant power plants for the generation of electricity by fuel power near coal mines; the saving and the utilization of the by-products of coal; the transmission and distribution of electric energy throughout the Commonwealth; the electrification of railroads; the generation of electrical energy by water-power; and the coordination of water power and fuel power development with the regulation of rivers by storage for water supply, transportation, public health, recreation and other beneficial uses.

Further on in the Act the Giant Power Survey Board which is to direct the work is charged—

> to keep in view the mutual interest of this Commonwealth and other States and to outline plans for the interchange of electrical energy with all other states within the practicable transmission distance.

As Pennsylvania with her huge fuel resources and intensive industrial development appears to be the heart of the Giant Power System—at least for the northeastern section of the country—it is well to have her attitude toward sister and neighbor states thus clearly stated.

In planning our Giant Power Survey—an "outline survey" the Legislature wisely called it—we are utilizing a method which, curious enough, appears to be almost unique in such inquiries, i. e. *we are studying the social needs first.* When we consulted the lawyers, they said, "Find out what you want to do and we will show you how to do it under the Constitution of the United States and the Constitution of the State of Pennsylvania." A little later the engineers—not to be outdone—responded, "You tell us what you want to accomplish and we will show you how to do it."

PERHAPS another point of departure from the usual is found in the fact that our first concern will be with the small user—particularly with the farmer. No system of electrical development would be technically sound if not built on estimates of the industrial power load. Just so, no system can be considered socially sound which ignores the more or less immediate requirements of upwards of 900,000 farm population, a million or more rural population not living on farms, and perhaps as many urban and semi-urban householders—now without current.

One of the most pronounced and untoward effects of the Industrial Revolution with its mechanical power was the massing of population in urban centers. If, under the Giant Power dispensation, mechanical energy can not only be made

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cheap but distributed broadly, authorities agree in predicting a spreading out of population—a veritable "back to the land" movement. Only at a few points in the United States has a sustained effort been made to develop a rural load. Even so these efforts have been in the more densely populated country districts or in territory contiguous to urban or semi-urban centers of population and therefore easily reached.

Just how far we can go in carrying power to the farmers of Pennsylvania will not be known until the survey is completed. We have roughly 200,000 farms and 100,000 miles of road. Hence, over the whole State our farms are one-half mile apart. In many of the counties the average distance between farms will be much less. In Ontario, where the Government owns the power system, they estimate the cost of constructing overhead rural lines at $1,200 a mile. Recently they have discovered that they can lay cable underground in rural districts at about $800 the mile. Interest and amortization charges on such an investment will evidently not act as a bar especially where farms average three or more to the mile. Experience in Ontario indicates that farms supplied with current sell for $1,000 more than those without.

France has recently created a fund of 60 million francs to be used in aiding groups of farmers to pay for rural lines. Under this arrangement the Government meets half the expense of such construction. In Ontario under recent legislation the Government pays one-half the "prime cost" which is interpreted to mean one-half the cost of lines along public highways or about one-third the whole cost of making rural connections. I cite these two cases to show that in other countries it has been considered so important to put power on the farms as to warrant government subventions.

In much the same way, cheap and plentiful power is almost sure to effect a wider distribution of our industrial effort. One of the impressive points about the "Hydro" system in Ontario is the fact that all the small towns from Niagara to Windsor (250 miles away) have access to power on relatively equal terms. Here industrial development is widely diffused and even small towns—towns "where the community mind has a fair chance to grow up and function"—are on somewhat the same footing as the larger centers.

Giant Power looks forward to making current at the places and under the conditions where it can be made cheapest and then transporting it, if need be, great distances to points of use. Competent authorities say that this is now fully feasible. There was a time when the cost of making "juice" (the vernacular for electric current) at the mine mouth was without special interest for the Bucks County farmer or even for householders in our larger cities. In each instance the controlling factor was the cost of making the current quite near home. Now however, every Pennsylvanian is interested in knowing the cost of producing power at the point where it can be produced at the lowest cost. This is because current made at any point within the Commonwealth can now be transmitted to any other point with a loss so small as to be negligible in the rate charged.

Not one pound of the 400 odd millions of tons of bituminous coal used in Pennsylvania each year for making power, is processed so far as I have been able to discover, for the recovery of those constituent elements which add nothing to its thermal effectiveness. In any school book on chemistry will be found a long list of desirable commodities which can be manufactured from these by-products: tar for roadbuilding, ammonia for fertilizers, delicate perfumes, and a wide range of medicines. To the by-product industry is given the largest share of credit for the industrial success of Germany before the Great War. Perhaps if we can learn how so to combine our Giant Power stations with by-products recovery plants as to stop this waste we can effect an economy which will more than offset the few mills difference between the cost of current developed from the best water power and that generated from modern steam or carbo-electric steam plants.

But under this new power dispensation there will be effected numerous changes, the gains from which largely elude the dollars and cents method of measurement, such as the elimination of the smoke nuisance from our cities. Again, our next peak of prosperity will see railroad facilities strained to the breaking point. There is no quicker or probably cheaper way of increasing present steam rail facilities than through electrification, thus not only adding to the mobility of equipment but making unnecessary the hauling of locomotive fuel. Cheap and widely distributed power would mean the removal of the coal load from the railroads, thus making room for larger quantities of graded commodities.

RIGHT here I cannot refrain from referring to the improvements in living conditions in the coal mining regions which may conceivably be effected by Giant Power. Through the building at the mines of Giant Power plants supplying hundreds of thousands of consumers the fuel demand will be stabilized, with all that means as affecting both miners' wages and income. In operations of this magnitude there is every incentive for the utilization of machinery and the elimination of back-breaking effort. With the probable reductions in price of electric current which Giant Power implies, it will be used in the homes of the miners as never before, first for light and then for washing, cooking, etc.

Giant Power developments can best be considered entirely apart from the broader question of public as contrasted with private ownership and operation. We have in Pennsylvania outstanding examples of effective public operation of utilities. But for the most part our public utilities have resulted from private initiative. This is especially true of the electric utilities. It may not prove a difficult task to coordinate these private enterprises under common policies. Their owners will doubtless welcome the opportunity to demonstrate that far-reaching social ends are as readily obtainable under regulated private enterprise as under direct public ownership and control. At any rate it is usually good judgment to build on what is until we discover a better way.

Some leadership on the part of the State government is required in any event. In the first place, many of the questions involved in any broad consideration of Giant Power developments are inextricably interwoven with the theory of regulation of public utilities under which we now operate. Further, where any matter arises which is likely to effect vitally two such outstanding industries as coal and transportation, it is only the part of wisdom for the State to keep itself advised. Again, more and more society acting through the State must take cognizance of waste, which, both as an element of present day cost and in its influence on the conservation of natural resources, has long since become a matter of deep public concern.

Altogether, then, Giant Power presents the prospect of a thrilling episode in nation building. It would appear to be an altogether hopeful task in social engineering to show how recent discoveries of science and developments in the art of power production may be applied so as to effect immeasurably for good the lives of all the people.

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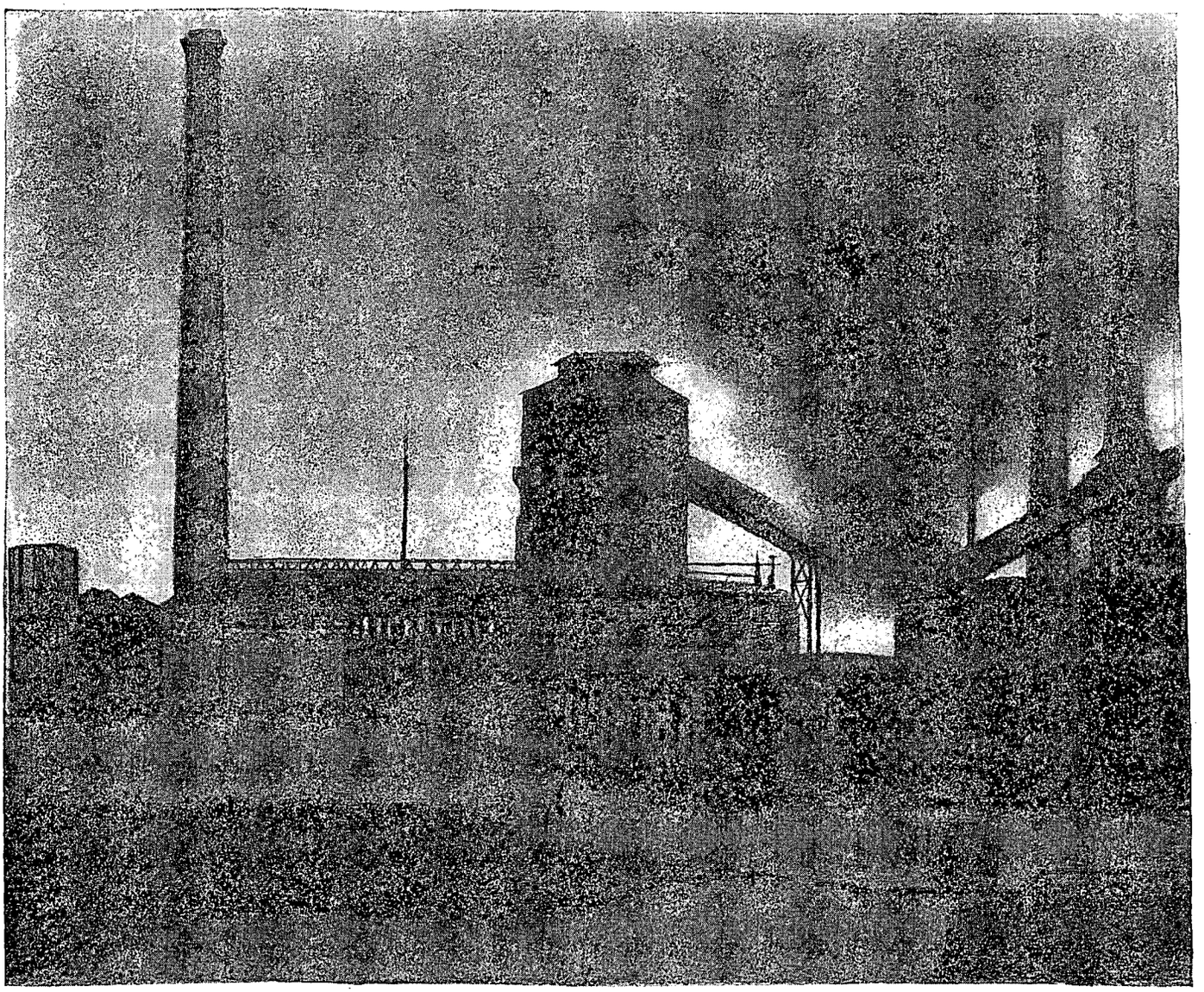

The Coal By-Product Oven

Drawings by JOSEPH STELLA

THE coal by-product oven is the major ally of the turbo-generator and high voltage transmission in creating the Giant Power system. The by-product ovens save the ammonia, tar and light oils that are wasted in smoke when raw coal is burned under the boilers of locomotives, stationary steam engines and domestic furnaces. This waste today is conservatively estimated at one billion dollars annually. By the integration of the by-product oven with the electric power plants engineers believe that the cost of carbo-electricity to the consumer can be economically reduced to the level of hydro-electricity at favorable locations like Niagara.

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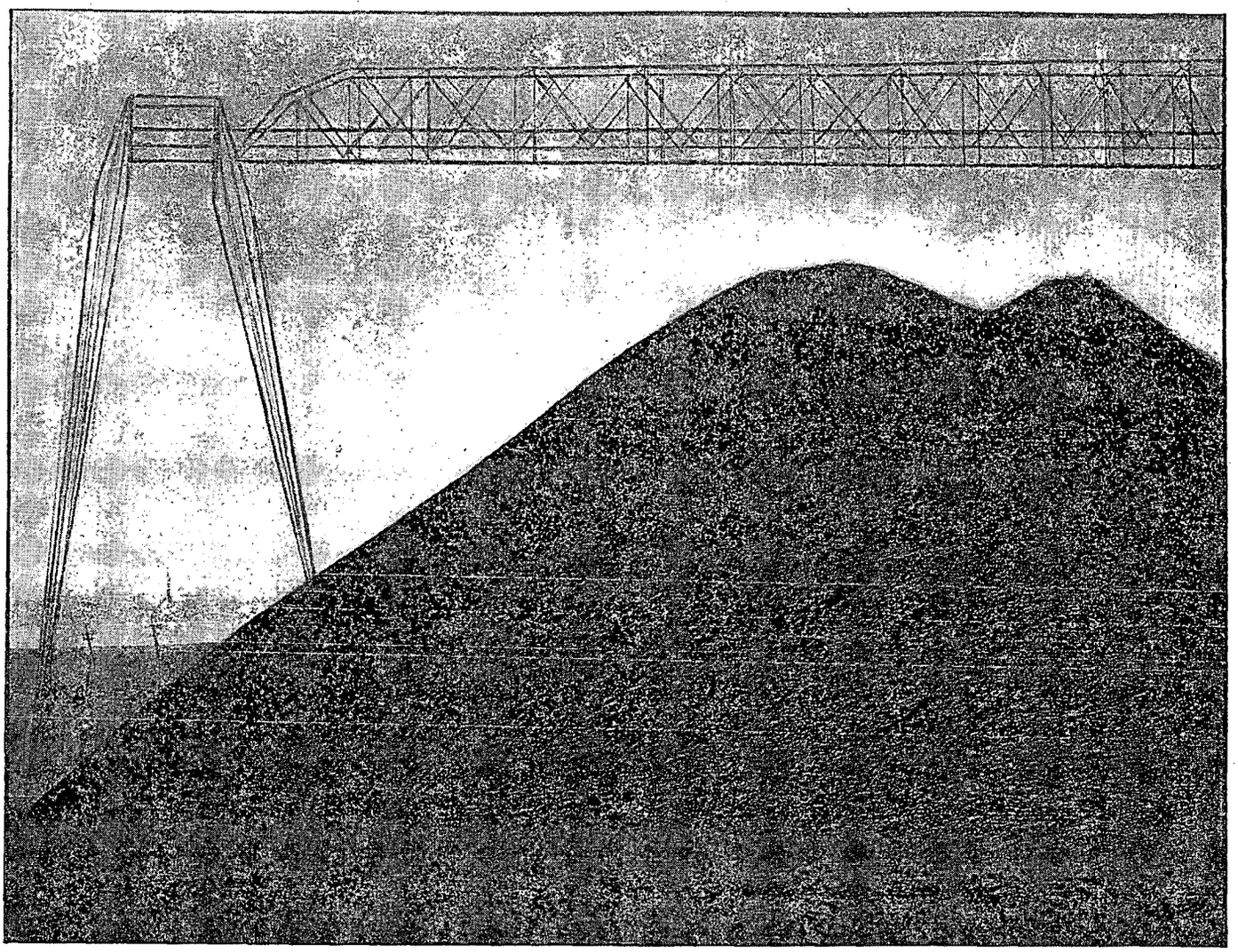

BITUMINOUS COAL STORAGE PILES

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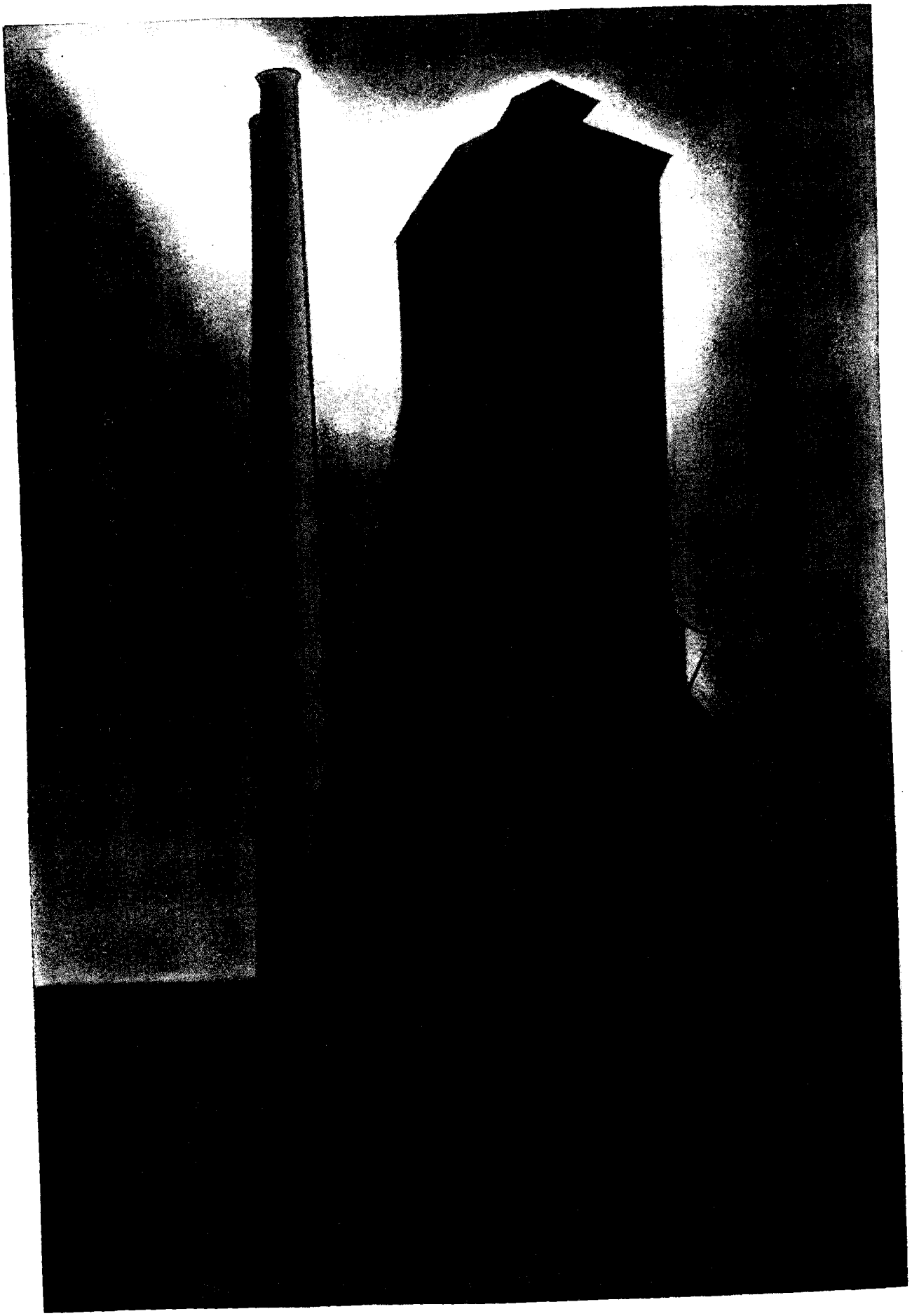

THE CRUSHER AND MIXER BUILDING

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THE TRAVELING PUSHER, WHICH LIFTS THE DOORS PROM THE OVEN, PUSHES OUT THE HOT COKE, AND LEVELS THE NEW CHARGE OF COAL

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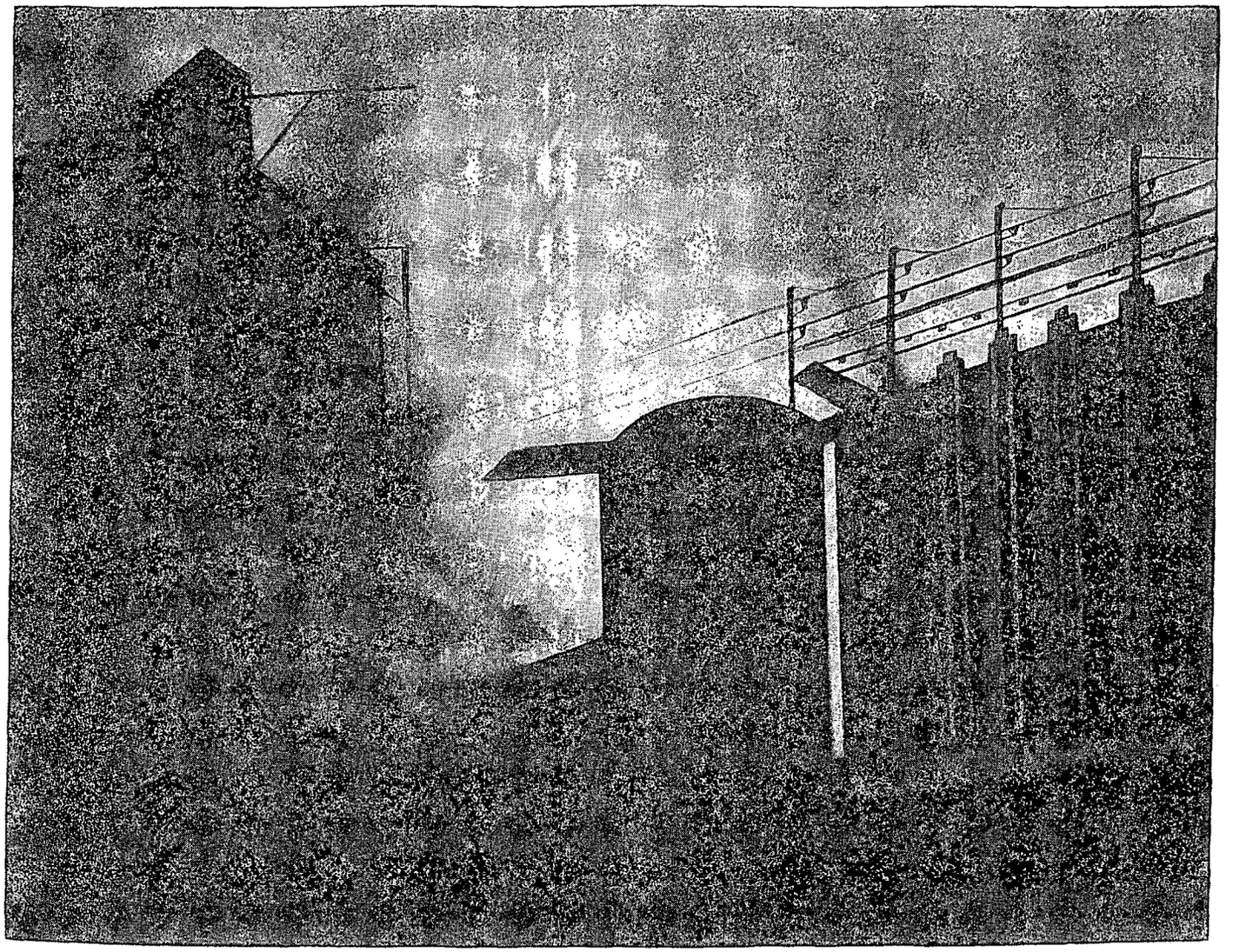

THE QUENCHER, TO WHICH THE GLOWING COKE IS CONVEYED IN STEEL CARS FOR THE WATER DOUCHE THAT ENDS COMBUSTION

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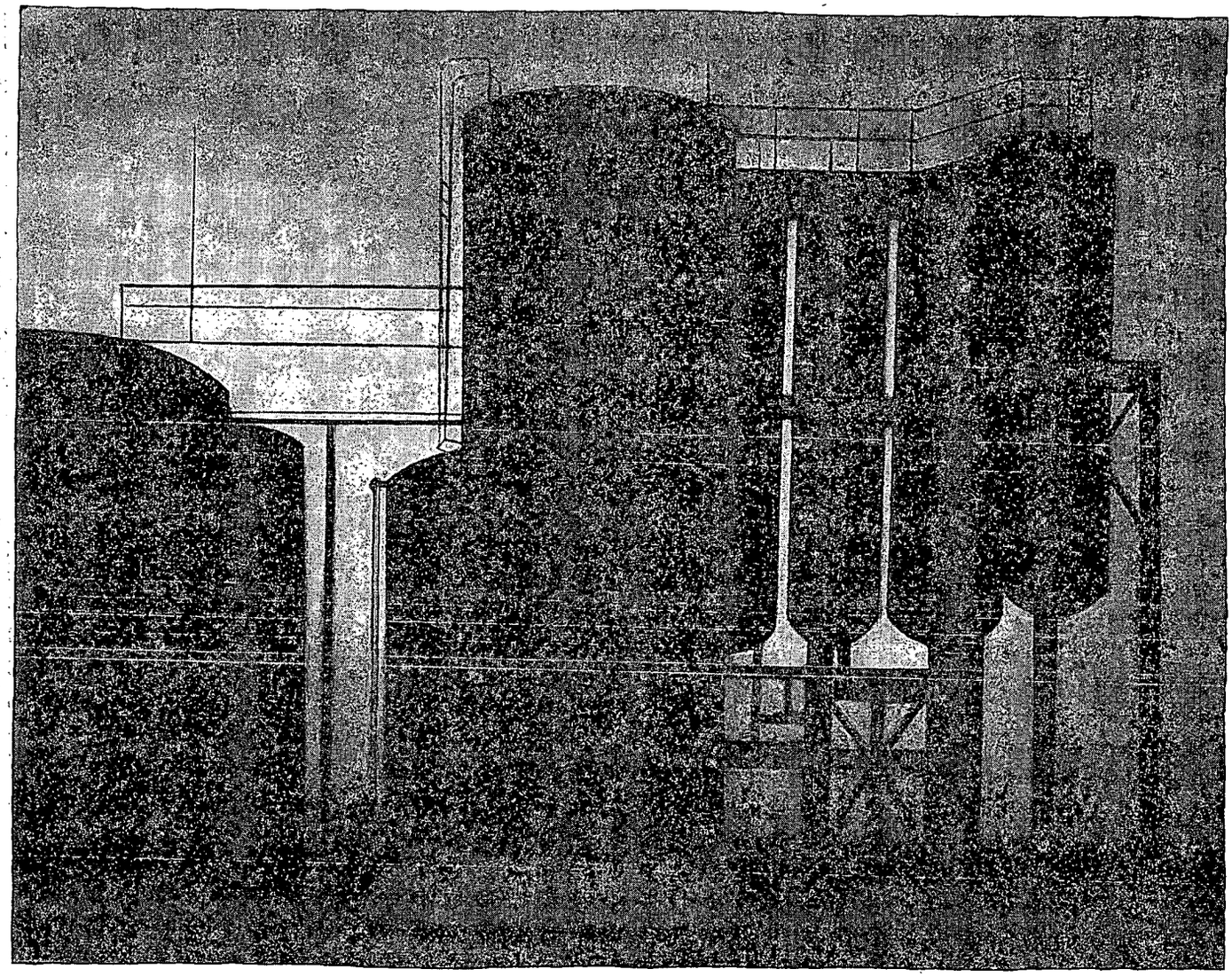

THE BY-PRODUCT STORAGE TANKS THAT RECEIVE THE DISTILLED AMMONIA AND TAR FROM THE OVENS

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Our Federal Power Policy

By PHILIP P. WELLS

COAL dominated the Nineteenth Century. The invention of the steam engine, its application to manufacturing in the Eighteenth Century and to transportation, especially by land, in the Nineteenth, shifted the economic base of society and profoundly changed human relationships. It increased a thousand fold the productive power of the manufacturing workman and at the same time broadened the market for the products of any mill until the inhabitants of the whole globe were potential buyers. Both factors united to compel centralization of manufactures and transportation in a few directing hands. The hand-power workman could no more compete with the factory engine than the horse could with the locomotive. By the same law, the small factory engine could not produce goods as cheaply as a big engine, nor could the local railroad carry them as cheaply as the trunk line. So the mills grew ever bigger, sucking into the tenements of the great new mill towns the workers of the villages; and the railroad systems grew ever larger, carrying to the remotest hamlets a flood of manufactured goods in any desired quantity, of standard quality at substantially uniform prices, and building up great cities at centralized distributing points.

The economists of the Manchester School looked upon this newly created world and found that it was good. Never in history had there been poured out upon mankind such a flood of things. Never were bellies so daintily fed, nor backs so sumptuously clothed, nor bodies so comfortably housed and tended in the world before. Do not hand laborers now have luxuries lately beyond the reach of princes? Is not the whole earth ransacked to bring them daily the fruits of the tropics, the silks of the Orient and other wealth innumerable? Was ever happiness in such danger of capture by its eager pursuers? Surely not, if men can live by bread, or its likes, alone.

There is, to be sure, another side to the picture. The results to date of the application of mechanical power on a great scale to the exploitation of natural resources, that is, to the production of the raw materials of manufacture, do not augur well for the distant future of mankind, nor even for the near future as to certain raw materials. Consider for a moment the mine, the forest and the farm. Mineral resources are being used at a rate beyond all experience and continually increasing in intensity. They are all limited in quantity and therefore exhaustible. Exhaustion is only a question of time. As to some of them the time limit is too remote to arouse present interest. As to others it is almost at hand.

"The woods go down like hay" before the donkey engine, the logging railroad and the giant saw mill. These exploit the forest like a mine, have their little day and vanish, leaving a desert behind them, incapable of producing another timber crop in any reasonable time. There are 83,000,000 such acres in the United States today and a timber famine is not far before us. It is clear that this kind of forest exploitation must and will be stopped. We shall turn our timber mines into timber farms.

But how about the farms themselves, the basic industry, the final source of food and clothing? The age of steam left the farmer's productive power comparatively untouched. It has, to be sure, been absolutely increased by horse-driven machinery, but the increase is as nothing compared with the increased capacity of the workman in manufacture or transportation. On the side of distribution, too, the farmer has been thrust aside, left in comparative isolation, in large part excluded from the comforts and luxuries brought to city folk by steam. This handicap is now beginning to be lessened by the gasoline engine, the tractor and the automobile; that is to say, by efficient fuel power applicable to agricultural production and transportation in small units.

IF we examine the matter critically it is clear that the centralization of manufacturing has not been due to the steam engine itself, but to the fact that the power of the steam engine could be transmitted to the workman's machine only by shafting, belt or other mechanical connection. This compelled the placing of the machine near the steam engine, which in this respect differed not at all from the water wheel. Indeed, the use of water power increased the tendency to centralization, for it was possible to haul coal to the steam mill, but the water mill must be placed at the waterfall. Lowell, Lawrence, Fall River, Holyoke, Manchester and Paterson are examples. It was not the steam-generation of power, but the mechanical-transmission of steam-generated and water-generated power, that drew the village craftsman into the mill town slum.

It found him a machine-owner, a capitalist hand worker, working perhaps in his cottage. He could not set up his own steam engine there. It made him the tender of a machine owned by the owner of the steam engine and hitched to it with a thousand, or many thousands, of other like machines tended by thousands of workers like himself, drawn from thousands of other cottages in scores of villages. Formerly each, in a large measure, was his own master at his work, as to the time and manner of it. Each had now become one of a disciplined force, trained to mass action. All must begin work when the steam engine was started in the morning, must cease when it stopped at night, and must work under the minute over-

The Issue of Control

Against the background of our industrial genesis, Mr. Wells puts before us in tingling passages the fourteen year fight for the Federal Water Power Act which Theodore Roosevelt, Gifford Pinchot and a company of driving roustabouts in Congress and out, carried through the legislative jam in 1920 on the freshet of the early conservation movement. They gave the American people a "clean slate to write the constitution of the new economic era."

He tells of its tremendous freightage for the common good: the snags it confronts today. His article affords a national approach to the problems of control which are like to be political issues in the years immediately ahead, and which are taken up from various angles in the group of articles immediately succeeding—federal, state and interstate, public and private.

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sight of a foreman or superintendent. Formerly families worked together at a common task for a common reward. Now their members worked perhaps in different mills, under different taskmasters, at different tasks and for separate rewards. The economic unity of the family was destroyed and the workman had bartered a large part of his liberty for increased productive power and a higher wage. The economic revolution found him somewhat like a farmer, an individualist. It left him somewhat like a soldier, subject to discipline, controlled by mass action, but unfortunately without the sense of a common peril and the common loyalty that redeems the soldier's life. In the place of these humanizing and spiritual motives the new industrial system put, or rather took over, as the main driving force of its enlisted armies, selfishness in unlimited and ruthless competition. Class antagonism and a breakdown of family life resulted. In the field of railroad transportation unlimited competition produced innumerable abuses until it came to be generally recognized that transportation in the changed economic order was too vital a function to be abandoned to unregulated private monopoly. We have therefore set up in this field a new system of public regulation which still staggers under the load of inherited absurdities and abuses.

INTO the economic order so constituted there has come with startling suddenness a new force destined to turn and overturn, to tear down and to destroy, to build and to plant. In a religious age such an apparition might be attributed to a divine and healing principle in human affairs which in time cures old social diseases, buries old social strifes, forgives old social sins and creates a new and unspoiled earth for the children of men. We materialists, if we took the trouble to think about it, would offer a colder and more rational explanation.

The art of long distance electrical transmission of power is barely thirty years old. In the early nineties a line eighteen miles long was, with many misgivings, opened in California. It operated under a pressure of 11,000 volts. Today there is in Oregon and California an interconnected network of lines 1,200 miles long from North to South, some of which are operating at 165,000 volts and are to be raised to 220,000 volts. In the Southeast a net work 600 miles long transmitted in 1922 power from Middle Tennessee and Western Alabama to eastern North Carolina. Without the ability to draw upon this interconnected pool of power, many cotton mills in the Carolinas would have been forced by a severe drought in that region to shut down.

There are great systems in Montana, in Washington, in Utah and southern Idaho, and in the Province of Ontario. The most intensive development within the United States has been in California. The trend there forecasts the future for the whole country.

IT is already clear that this new art, under proper public control, will do for power what the railroad did for goods. That is, it will bring to every man's door power in any desired quantity, of standard quality, and at prices substantially uniform for each class of service. This power will be furnished from a common reservoir into which will be poured substantially all energy generated by steam and water power, and from which all men will draw the power they need. The art has already developed to the point where economy calls for great power districts, each including many states. In the Northeast such a system may extend, under present conditions, from Maine to Virginia and from Boston to Cleveland. The future interconnection of all such districts to make a nation-wide system is cleary indicated.

Elsewhere in this issue it is made clear why the big steam engine in the big mill will be unable to compete with the giant power plants, steam and hydro-electric, of the new system, and why simultaneous demands on the power system, instead of being a necessity, as in a single mill now, will be economically wasteful and therefore a handicap. It is enough in this place to state the two controlling maxims of the new order:

(1) The greater the number of interconnected efficient generating sources, the cheaper the power;

(2) The greater the variety in time of use the cheaper the power.

It follows that all water powers in each power district must be interconnected, and thereby averaged, and that the water powers must be connected with the steam powers. So far as power is concerned the artisan may now go back to his cottage, assemble his family, set up machines for himself and for them there, to be driven by power from the common reservoir, and thus regain both his freedom and his family life. Of course other influences operating against cottage industry will remain. But it is clear that the greatest advantage of the big mill over the little one is disappearing, while its weaknesses in the region of class antagonism, low morale and the general cost of congestion are growing more clear every day. Already it is possible for men having the requisite skill and ability to start small mills with a minimum of capital and yet on equal terms as regards production with the large mill, often on better terms.

The farmer, too, may now have, and will rightfully demand to have, power delivered according to his needs for working his stationary farm machinery, for pumping water to his stables and his bath room, for lighting, sweeping, washing, ironing and other household tasks. He will share in the common stock of power on equal terms with the city dweller both for increasing his production and for securing an equal share of the comforts and luxuries produced by the increased output of all workers.

In this new world of electrified industry water power is to play an important part. It will last forever. Its use will greatly prolong the life of our mineral fuel deposits. It saves labor in the generation of electricity. Only a fraction of it (some 14½ per cent) has been developed, much of that under Federal control. The great bulk of the remainder, by reason of the principles of the law of waters, has not passed over from the public domain into unrestricted private ownership, and 85 per cent of that remainder, say 39,000,000 horsepower, is within Federal jurisdiction. If we add the fact that the cheap development of electric power by steam in Giant Power plants at the coal mines is dependent upon a supply of water for condensing purposes, which is again dependent upon state authority for storage and cooling works, it is evident that the American people have a clean slate whereon to write the constitution of the new economic era.

IN view of these facts the timeliness of the Federal Water Power Act of 1920 is noteworthy. Broadly speaking, the water power resources of the United States may be said to have been substantially untouched when the fight for the Act began seventeen years ago. At the very moment when the advance of electrical science first made them worth the seiz-

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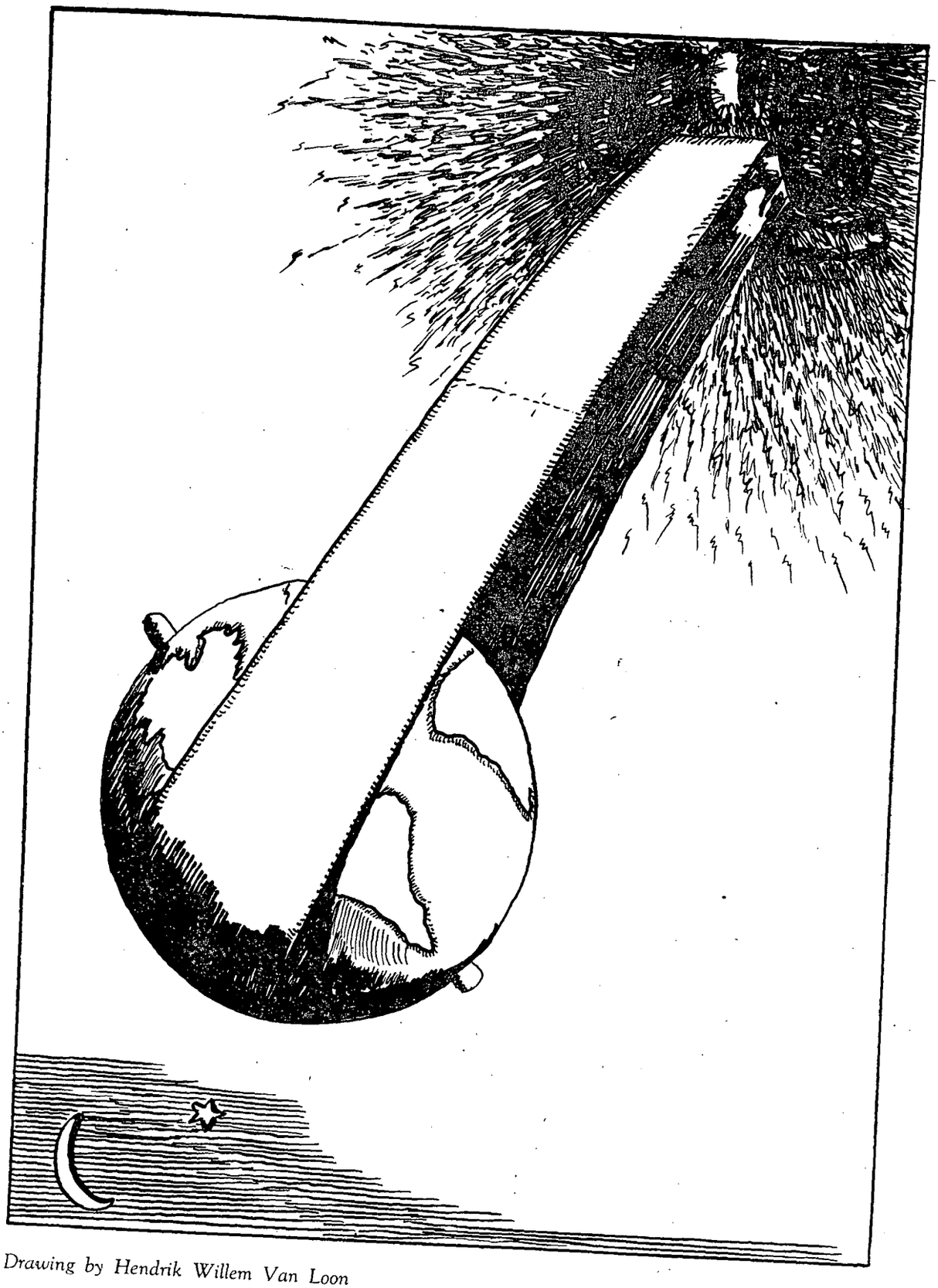

Drawing by Hendrik Willem Van Loon

GIANT POWER STRETCHES THE INDUSTRIAL BELT

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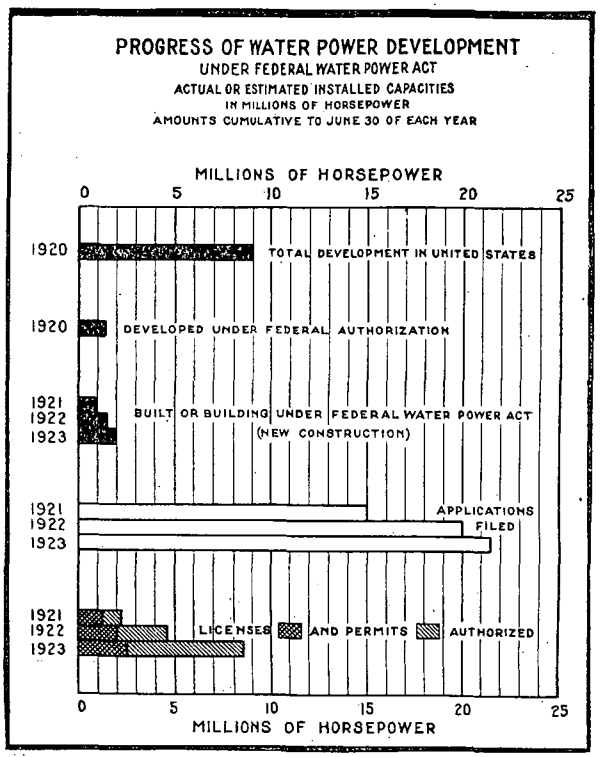
ing by private interests, the constructive vision of Gifford Pinchot, backed by Theodore Roosevelt, undertook to preserve such public control of them as would prevent the repetition of the blunders and crimes of the era of railroad expansion, this by insuring their development for the general welfare while offering to private capital a fair reward for its share in such development. The greater part of the development that has taken place since 1906 has been under Federal control and has, or will, voluntarily come under the Act of 1920.

No other statute ever written in this country, with the possible exception of the national forest laws, has dealt so soundly and constructively with the fundamental economics of production; and the forest laws came, not in time, but too late, unless and until they are supplemented to impose strict control over forest lands already in full private ownership. The Federal Water Power Act is the best product to date of the movement for the conservation of natural resources. Up to the time of its enactment no state had embodied its principles in law. Since its enactment New York has partially echoed it in a spirit of rivalry, and Pennsylvania has recently supplemented it in a spirit of co-operation. Up to the time of its enactment state rights and state authority were appealed to only in order to obstruct and prevent the adoption of its principles.



Prior to the passage of the Federal Water Power Act on June 10, 1920, 1,430,000 hp. had been developed on public lands and navigable streams. On June 30, 1921, there were applications under the Federal Water Power Act for 15,000,000 hp. pending or acted upon: on June 30, 1922, 20,000,000 hp.; on June 30, 1923, 21,500,000 hp. It is to be noted that development of much of the latter may not be undertaken for several years, and some may not be undertaken for many years. Nevertheless, it is indicative of increased activity in water power development.

WHAT then are the principles of the Federal Water Power Act? It limits all water power licenses to a maximum period of fifty years, at the end of which the Government may renew the license to the same licensee, or may take over ("recapture") the project upon payment to the licensee of his actual net investment, or may turn the project over to a new licensee upon like payment. States and municipalities are given preference over other applicants for licenses, provided their plans show an equally good use of the navigation and water resources of the region. Licensees must make full and prompt development and must contribute equitably to the cost of upstream storage reservoirs built by the public, or by another licensee, such contribution to be in proportion to the benefits derived from the storage during periods of low water. The net investment (cost prudently incurred) is the basis of their rates; of the issue of the securities, and of the recapture price paid by the public or the new licensee. Profits in excess of a reasonable return on the net investment must go to the public either as a partial amortization of the net investment or in the form of annual rent paid to the United States. A small nominal rent is paid in all cases of private development to defray the expense of administration. State authorization for use of the stream, its bed and banks, must be shown before a license issues, and the licensee must submit to state regulation of his rates, service and security issues, under penalty of forfeiture of his Federal license.

Such are the safeguards of public rights established by the Act. To the investor and promoter on the other hand it assures a good title for fifty years, reimbursement of the actual net investment if the license is not renewed, and a reasonable opportunity for a fair return on the net investment in the meantime.

There is not space here to tell the story of the seventeen year fight for the Federal Water Power Act, though it would be worth the telling. The strategy of the forces fighting for it was from first to last an application of the economic and political theories of the conservation movement. They fought with whatever weapons they found at hand. First and most important, the immense prestige and force of President Roosevelt, without which they would have been swept off the field at the first shock of conflict; then the Executive Power broadly conceived and boldly used; then popular agitation through press and platform; then a change of party control in the House of Representatives; then the rivalry of two House Committees; lastly the legislative filibuster in a dangerous crisis.

Litigation in which all our basic legal and constitutional contentions were upheld by the Supreme Court should not be omitted from the list. Party lines cut no figure at any time. We found strong champions in both parties and hard-hitting opponents in both. We won first the Forest Service which remained steadfast throughout; then the general public, then the Department of Interior under Garfield, losing it under Ballinger, but recapturing it under Fisher; then the War Department under Stimson, then the House Committee on Public Lands; then the House Committee on Interstate and Foreign Commerce and the House Organization; last the Senate, though we had had a steadfast, hard-fighting, bi-partisan group of allies there from the first. Conspicuous on our side in the executive departments were President Roosevelt; Gifford Pinchot and Henry S. Graves, Foresters; Herbert Knox Smith, Commissioner of Corporations; James R. Garfield and Walter L. Fisher, Secretaries of the Interior; Henry L. Stimson and Newton D. Baker, Secretaries of War; and Oscar C. Merrill, Engineer of the U. S. Forest Service.

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now Executive Secretary of the Federal Power Commission. In the House we had Parsons of New York, Kent of California, Lenroot of Wisconsin (later in the Senate), Ferris of Oklahoma, Sims of Tennessee; in the Senate, La-Follette of Wisconsin, Norris of Nebraska, Dolliver and Kenyon of Iowa, Gronna of North Dakota, Husting of Wisconsin, Lane of Oregon. Of course this list is far from complete. Geographically the opposition's stronghold was in the South and Far West. The Senators from those sections were the Old Guard who held out longest. Our stronghold was the Middle West. The electrical industry fought us fiercely and unitedly from 1906 until 1911. Then they split for a time. The Stone and Webster interests accepted our principles and agreed with Secretary of War Stimson upon the Connecticut Dam Bill as an application of them. This bill was defeated by the combination of Southern and Far Western Senators in 1913. The industry again closed ranks in opposition until 1917. By that time we had definitely captured the House Organization and the industry sent in a flag of truce. Negotiations were resumed and a general bill, better than we could have hoped for at the outset, but still defective, passed both houses and was reported from conference committee. Amendment was now impossible, but we called upon LaFollette and he stopped it by threat of filibuster in the closing hours of the Congress that expired March 4, 1919. In the next Congress, negotiations were resumed, a satisfactory bill agreed upon and passed.

THE Act applies identical economic principles to two distinct legal fields. Wherever the Federal Government is landowner, especially in the national forests, most of which are in the mountains of the Far West, water power development is impossible without the use of Government land for reservoirs, dams, canals, power houses, transmission lines and other structures. Here developments are by high heads—relatively small quantities of water falling great distances (often 1,000 feet or more) upon the water wheels. In the lowlands we have low heads and must have a proportionately greater quantity of water to generate the same amount of power. Nearly all rivers which contain enough water to generate large quantities of power at low heads are legally navigable and therefore arteries of Interstate Commerce. As such they are subject to Federal control and are the objects of Federal expenditure in river and harbor bills. Often the best way to improve their navigation is to build dams so as to flood out the falls and rapids and convert the stream into a series of slack-water pools connected by locks. Such dams give a head of water and develop water power. The Federal Water Power Act therefore treats water power development in the mountains as a use of land and in the lowlands as an improvement of navigation. In either case it gives a license for a limited time and on like conditions. This legal distinction made the cooperation of two committees of the House (Public Lands and Interstate and Foreign Commerce) necessary to its passage. Out of their membership a special joint committee was created in the House to consider and report the bill. The Act creates a Federal Power Commission consisting of the Secretary of War (having control of navigable rivers), the Secretary of Agriculture (having control of national forests) and the Secretary of the Interior (having control of other public lands and reservations). The actual work of the commission is done by its executive secretary, who is an expert hydro-electric engineer, and his clerical staff, aided by experts detailed from or working in the three Departments.

THE electrical industry as a whole has accepted the Act in good faith and is busily developing water power under it. But new snags have been encountered by this current of federal policy and development in unexpected quarters. The state of New York has brought suit in the Supreme Court of the United States to annul the Act as an unconstitutional infringement of the sovereignty of the state. This suit was begun under Governor Miller, Republican and opponent of state ownership and operation of hydro-electric plants. It has been continued up to this time by Governor Smith, Democrat, and advocate of state ownership and operation. It is fairly apparent that a compelling motive behind this suit was the jealousy of commercial interests in New York which desire to prevent or delay the opening of the St. Lawrence and Great Lakes to ocean going ships. The most essential item in that project is the damming of the St. Lawrence so as to create navigable pools connected by locks. This would cost a vast amount of money, but would produce a vast amount of water power which might be worth enough to pay for the whole project. It is obvious that if New York can establish the legal doctrine that the United States must pay for the American share of the dams and locks, leaving the State free to appropriate and sell the American share of the power developed by the dams, it will succeed in delaying the project for decades.

A SECOND snag is a popular hero—Henry Ford. His offer for the government dam now building at Muscle Shoals, Alabama, on the Tennessee River, violates every one of the principles of the Federal Water Power Act, except the principle of full development, and asks an enormous subsidy from the Federal Treasury into the bargain. The offer should be so amended as to conform to the principles of the Act. Otherwise its passage would be a repudiation of those principles pointing to their complete abandonment. Curiously enough, the Ford offer is persistently advocated by professed representatives of the progressive farmers of the Middle West whose senators and congressmen were the staunchest fighters for the Act before its passage. The vigorous attack upon the Ford offer by Senator Norris of Nebraska gives abundant room for doubt whether this political element has undergone any change of mind or heart on the water power question.

A third snag is government inertia and red tape. The wording of the Act has been so construed by the Comptroller of the Treasury as to forbid the direct employment of experts by the commission and to require that the Departments of War, Interior and Agriculture do all expert work. Now it is vitally essential that existing projects which have come under the Act be valued at once, as a basis for their rates, for the recapture price to be paid for them at the end of fifty years, and for the measure of their excess profits, if any. The three departments have no valuation engineers and the valuation remains undone. The Act should be so amended as to enable the commission to directly employ and pay its own expert staff.

A fourth snag is popular indifference. A great public agency of this kind, dealing constantly with representatives of great corporations whose interests are, in some respects, adverse to the public, should (*Continued on page* 649)

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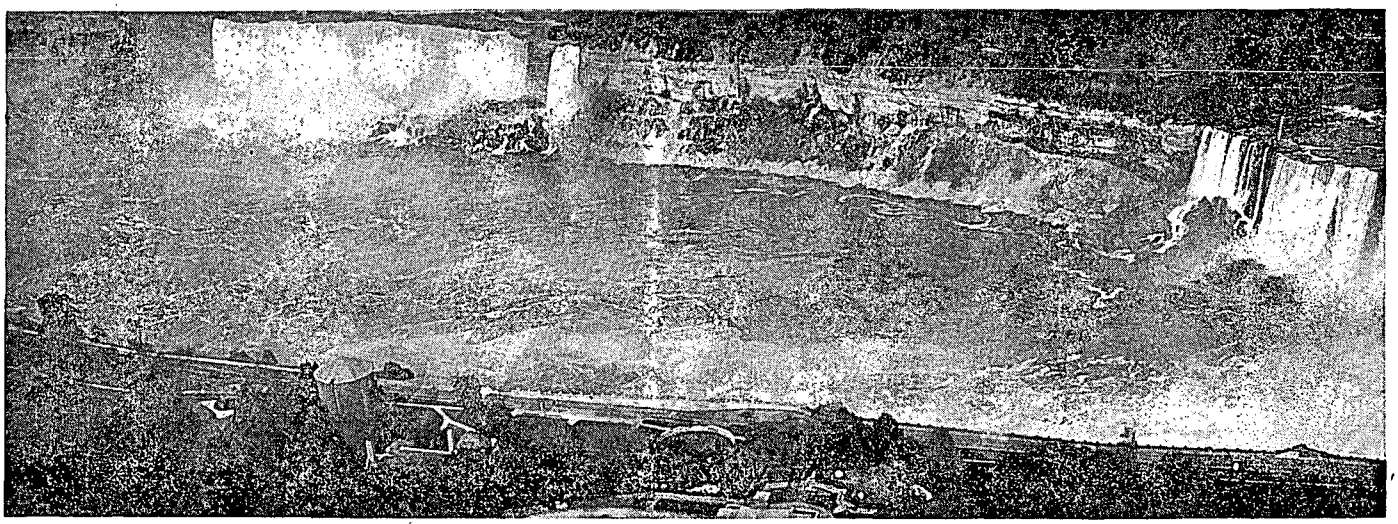

Niagara Falls

The Stake of the Public

By ALFRED E. SMITH
Governor of the State of New York

ALMIGHTY God in His Divine Wisdom blessed this great country with very many great natural resources, divided among many states. Some states are rich in copper deposits, some in oil, some in mineral wealth, some in coal, but our own state of New York can properly boast of the greatest natural water power resources conferred upon any single state of the Union. What good would any of them be if we failed to develop them? Coal hidden away in the earth in Pennsylvania would not contribute light and heat to humanity unless some one took the trouble to mine it, clean it and transport it. What good would oil be, hidden away in the earth, unless some one took the trouble to drill for it, bring it to the surface and transport it? What would the great marble deposit of Vermont mean to the country unless some one cut it from the earth, prepared it and transported it?

Naturally thereafter, the question arises, what good is all of this great water power to the state or the nation unless it is developed? While we in the State of New York have been carting coal and oil for fuel purposes from other states, we have sat idly by and allowed potential electrical power, capable of taking the place of countless thousands of tons of coal, to run to waste; and I cannot help saying, in view of the water power history of the state, that we deliberately permitted it to so run, for it cannot be said that the men at the head of the government of this state do not understand the water power possibilities of the state. The fact is that they do, and the delay in bringing it into action rests entirely upon the political question involved, whether it is to be privately or publicly developed. By private development we mean a grant on the part of the state either to private individuals or private corporations to develop it for profit. By public development we mean its distribution to all the people of this state, at a price that makes this resource a public benefit.

First, let me deal with the power resources of the State. There are two kinds of possible power developments. One is what might be called firm power, or power that can be delivered at a maximum capacity every day in the year. There are what we call occasional developments, or what is known as dump power, that must be supplemented by steam power. The basis of good development rests upon our ability to supply firm power; that is, power every hour and minute of the day, every day of the year. As to this, New York state is particularly rich because we have the rapids of the Saint Lawrence River and the wonderful waterfall at Niagara Falls awaiting complete development. Aside from this we have any quantity of inland streams, rivers and waterfalls that, if properly regulated, could be feeders to take care of what is known as the peak load of a great system of water power development.

Our trouble is political. A certain group of men in the state believe in absolutely private development without return to the state at all. A second group believe in private development with a nominal financial return to the state. A third group believe in state development, under state ownership and state control. I am forced into membership in the third group, simply because of our history in the past. Beginning in 1895, the legislature of

The Case of State Control

GOVERNOR Smith stands for state ownership and development of natural resources—water power among them—as against private exploitation. He stands for state development and control as precedent to any interstate or federal arrangements. He tells of the struggle for a decade between public and private interests in New York which to date have largely negatived each other; and as a way out advances his project for a state power authority, comparable to the port authority at the mouth of the Hudson. He sets forth New York's position in contesting the Federal Act and at the same time as chief of the commonwealth which borders the great Niagara gorge, expresses his readiness, provided New York's interests are safeguarded, to link Niagara up as a unit in any possible national Giant Power system.

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this state gave by law grants of power to corporations to divert water from the Niagara River above the Falls, and so notorious grew their lack of care of the great natural beauty of the Falls that ten years later the United States Government was compelled to reach its hand into this state to protect the scenic beauty of the Falls, and, by the passage of what was known as the Burton Act, limited the diversion of water by a treaty with the Dominion of Canada. The private water power interests, finding themselves blocked at Niagara Falls for future power development, made an attack upon our next great source of supply and the Legislature incorporated what was known as the Long Sault Development Company which, by charter, was granted the right to dam the waters of the Saint Lawrence river at Croill Island and Long Sault, making possible a development of 500,000 horsepower, all of which, by treaty with the Dominion of Canada, was the property of the State of New York.

In 1913, the Legislature repealed this charter, permitting the company to go to the Court of Claims and recover from the state any money spent in pursuance of that development. It was a remarkably small sum and on appeal the Court of Appeals sustained the constitutionality of that act, the net result of which was to return to the people of the state what belonged to them for development as they saw fit.

Immediately after the passage of the Long Sault Development charter, the same Governor who signed the bill had enacted into law a statute that placed upon the then water commission the duty of preparing and presenting to the legislature a comprehensive plan for the development of our water power resources under state ownership and state control. I call your particular attention to the words "under state ownership and under state control," because that was the very essence of that particular statute.

In 1911, the State Water Commission was consolidated with several other state departments into what was afterwards known and is now known as the Conservation Commission, and in pursuance of the command of the legislature, the newly instituted Conservation Commision did in 1912 present to the legislature a comprehensive plan. There again politics entered the arena; one house was dominated by one political party and one house by the other. The bill passed one house and was defeated in the other.

In 1913, it met with further defeat by executive action. In 1914, the performance of 1912 was re-enacted. In 1915, the statute was entirely weakened by inserting in the law a provision that no plan for future development would be enacted without the consent of several state officials. The private water power interests had for the time scored a complete victory. As a consequence of such victory, no plan of any kind was proposed.

In 1919, I proposed a plan. The bill embodying my proposals was passed by the Senate but defeated in the Assembly. In 1920, it was defeated in both houses. During 1921 and 1922, various water power measures were enacted but all looking to the policy of private development under license from the state.

In a special message to the legislature in 1923, under date of March 6, I proposed and submitted with the proposal a bill providing for state development under state ownership and state control, which passed the Senate and was defeated in the Assembly. So that we find ourselves today in the position of still having these great resources awaiting development. In view of our past history, I am unable to bring myself to the belief that these great undeveloped water powers should be given away to anybody, and I am unable to detach myself from the firm conviction that the people themselves own these resources and they should be developed for their benefit and by the state, because I am firmly of the belief that only by state development can the people get the ultimate benefit of a reduced price in electrical energy. Our history shows that to be a fact.

There has been considerable public discussion about the law suit on the part of the state against the Federal Government testing the constitutionality of what is known as the 1920 water power development act. For as many years back as the mind of man can run, we have been led to

A State "Power Authority"

"I . . . advocate that we establish a New York State Power Authority which shall be a public corporation, municipal in character, having no stockholders, deriving its powers from the State and having duties specifically imposed upon it, to take over and develop the power resources of the State. Such a public corporation should be given power to issue bonds, which should be exempt from State taxation, secured entirely by the revenues to be derived from the improvements when made . . . The valuable franchises which the State itself would own, would be capitalized, not in the interest of private stockholders, but in the interest of the public. The service which it would render in furnishing cheaper light, heat and power would be subject always to the control and regulation of the State itself . . .

". . . Such authority should be empowered to cooperate with the Canadian authorities and perhaps eventually to form a general commission with a similar group from Canada for the development of the Niagara and St. Lawrence powers . . . We are ready to deal with anybody for the use of our power in return for power from other States . . .

" . . . I am firmly convinced that if we do not set up an authority of this kind no progress can be made. The political, social and economic factors in this problem will not permit unregulated private development. The people of the State will not give up their rights to any regional super-power monopoly on the basis of the slogan that there shall be free flow of power across State boundaries . . .

"This is a definite proposal, practical and capable of immediate usefulness. It contemplates no added financial burden on the State and enables the State to develop its own resources immediately and to participate in any interstate or international projects protecting our own rights and conserving them for the benefit of all the people."

Excerpt from Governor Smith's Message to the Legislature on January 2, 1924.

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believe that we owned the bed of the streams within this state. We have been further led to believe that federal authority extends only to the regulation of navigation; but by the water power act of 1920 the federal government presumed to have the right and title to the possible power development on these streams. This, of course, we strenuously deny. While it is true that that Federal Water Power Act gave the state the preference, it, nevertheless, attempted to establish as a fundamental principle the belief that the ultimate ownership of them rested with the federal government, because by its provisions, if the state did not develop, private corporations were permitted to develop upon federal governmental license. This principle we deny and, I believe, rightly so.

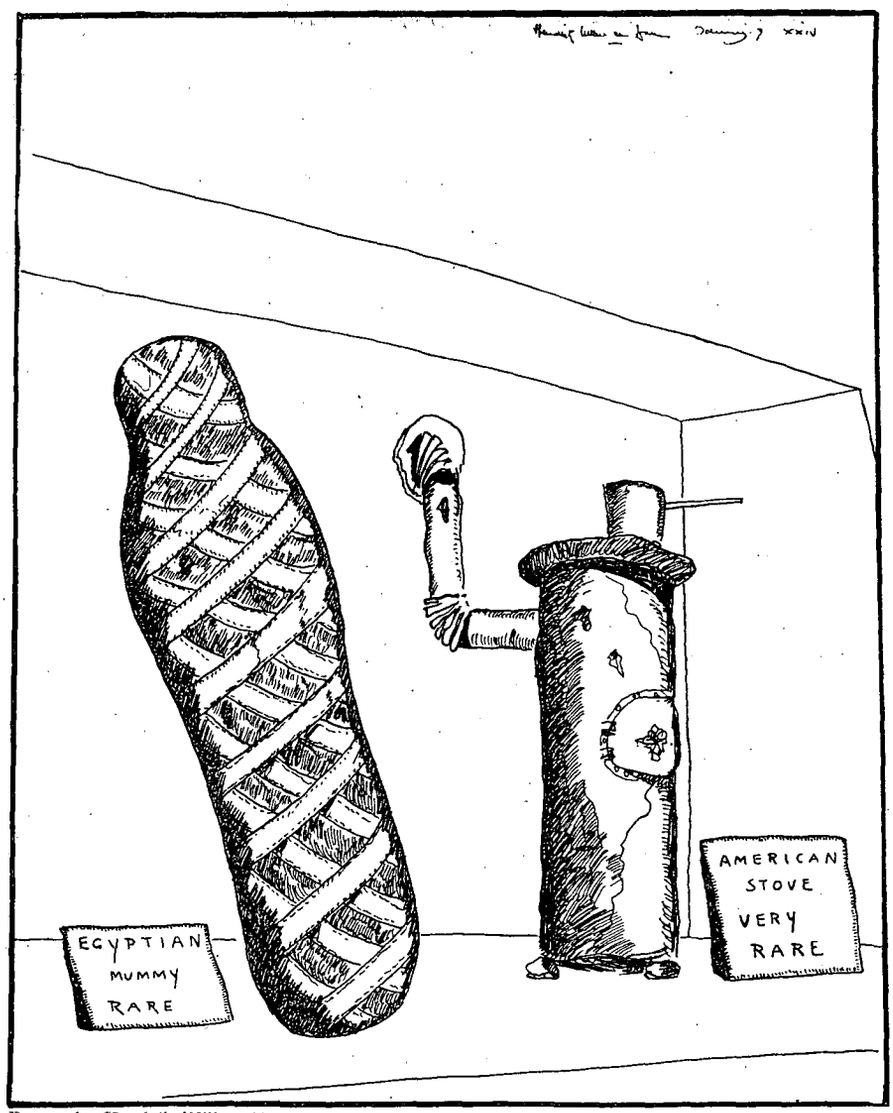
The present status of the federal suit instigated by the state of New York is that it remains in abeyance, both sides stipulating that no evidence in such suit is to be taken. No overt act being committed by the federal government against the sovereignity of the state leaves the state without specific complaint; but the principle involved we will contest to the very last degree.

Now let us get right down to the question of what to do with this great power when developed. I can only repeat what I said to Governor Pinchot of Pennsylvania when he asked me to consent to the discontinuance of the state's suit, and that is this, that I am in accord with his belief that the time is not far off when there will be an interstate exchange of electrical energy, in which event, of course, the state of New York would be one unit; and I further said to him that under such so-called superpower scheme it is possible that the state of New York may ultimately determine that the people of the state of Pennsylvania or any other state would be entitled to consideration in the distribution of our electrical energy, but I did insist, and I think I was within my rights as speaking for the state, that when that happens with what we believe to be New York's property, the state of New York should make the bargain and not the federal government. Let the federal government remain within its own sphere. We need no assistance from it to promote helpfulness and consideration as between the states. If Pennsylvania has anything to offer New York State in the way of power possibilities, or if Massachusetts has anything to offer along the same line, let the bargain be between the states.

Recently the federal government recognized the complete right of states to joint development of natural resources as is seen by the ratification in Congress of the compact between the state of New York and the state of New Jersey for joint port development. I am ready to agree with any state on joint development, or with all the states for that matter, but I insist upon two cardinal, basic, fundamental principles. The first is, that the possible power development from the border and inland streams of the state of New York belongs to the state, and, second, that any bargain made for superpower development be made upon the basis that the power given from New York is her property.

If I were to conclude with one definite suggestion, I would feel that I had made my full contribution to a solution of the entire controversy, not only as it affects our own state but as it may relate to other states, by offering the simple proposition that New York state at the earliest possible moment provide itself for the immediate development of the firm, sound, consistent horsepower possible from Niagara Falls and the Saint Lawrence River, which power, after development, is to remain entirely within the control of the state. When we have reached that point, future developments can take care of themselves and incidentally take care of us, because we will have in our control the key to the great possible power development of the East.

And let me in conclusion say that after we have established our power plants, we will be far from selfish. In fact, we will be ready to link it up as a unit to any possible national power development; provided, of course, as it would be natural for us to seek, that the interests of the state of New York and her people in the ownership of this water power be thoroughly safeguarded.



Drawn by Hendrik Willem Van Loon

In the museum of tomorrow

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Giant Negotiations for Giant Power

An Interview with Herbert Hoover

By WILLIAM HARD

"OH, but by engineering we can make much better waterfalls than have been made by nature." Half in play and half in great seriousness Mr. Hoover made this rejoinder to a lady who was expostulating with him for his enthusiasm on behalf of the turning of water into waterpower.

It would not be a bad guess if one were to say that among the extraordinarily numerous activities and impulses displayed by Mr. Hoover a sort of priority in romance for him is still held by the occupation of his youth and that if people came to him and said, "You may build the dam in the Boulder Canyon in the Colorado River," he would at least for a long unhappy moment find his occupation of being Secretary of Commerce extremely tedious. Mr. Hoover was, is, and will be, at heart an engineer.

It happens that now by much experience in public affairs he also has had an opportunity to become familiar with public political negotiations. It further happens that admittedly the next great engineering development in the United States is the carrying of electric power, from coal and from flowing water, across state lines to new great distances and on a new gigantic scale of volume, and that in this development there will arise, and already arises, the necessity for public political negotiations protracted and complicated, local and regional and national.

It was inevitable then that Mr. Hoover, our most distinguished combination of engineer and of public man, should early interest himself both in exhorting his fellow-engineers to address themselves to the problem of "giant power" and in personally participating in the negotiations which that problem produces. Many months ago Mr. Hoover expressed to the American Engineering Council in a meeting at Washington his conviction that "in the consolidation of hundreds and even of thousands of minor electric power plants, and in the possibility ahead of us of the development of some twelve to fifteen millions of electrical horsepower, and in the enormous savings which can be made through the substitution of electrical power for steam, there lies before the American people the probability of the greatest material saving of waste possible in any country."

When Mr. Hoover thinks of waste, he is at once moved to action; and he is not dissuaded from action even if the waste is in a waterfall protected by the vigilance of the National Women's Scenery Conservation League.

To the lady who was personally endeavoring to get him to promise to leave God's waterfalls alone there came from him the following words of engineering impiety and aspiration:

"Some waterfalls are in the wrong place, where few people can see them. Moreover, in many waterfalls the same effect could be secured by a smaller expenditure of water. Waterfalls could be constructed with a view to their better public availability as scenery; and the sheet of water used to produce the scenic effect could be much thinner. We could save water and we could also have waterfalls in better locations if we handled the subject of waterfalls with the aid of human intelligence added to the resources of nature. Scenically as well as industrially we can be better off through the civilizing of our rivers."

The lady seemed not quite convinced but behind Mr. Hoover's laughter there was a genuinely serious philosophy to the effect that for the beauty of the world, as well as for its utility, much could be done by that favorite personage in Mr. Hoover's calculations—the public spirited engineer.

ENGINEERING and public service unite in Mr. Hoover's conception of the "giant power" development now lying before every region of the United States and also before the United States considered as a whole. It is to be observed that the phrases "giant power" and "superpower" have led to certain misapprehnsions in the public mind. It has been supposed in some quarters that some sort of magical new variety of electric force was about to be disclosed. The public political aspect of the matter is made clearer for most people when it is realized by them that what is happening in electric power through technical improvements in transmission is that today we come to an era of great electric power consolidations analogous in a way to the consolidations which have given us our great interconnected railroad transportation systems.

The Pennsylvania railroad transportation system includes properties originally owned or operated by some six hundred different corporations. Even today, within the Pennsylvania System, there exist one hundred corporations.

The coming integrations of sources and highways of electric power bear a certain resemblance to the integrations already accomplished of highways of railroad freight and passenger movement. Because of the peculiar nature of electricity, however, there is another anal-

Treaties Among States

HOW Mr. Hoover cut the knot of conflicting regional ambitions in his work as chairman of the Colorado River Commission, and tied in its stead an agreement involving seven states, is the text in Mr. Hard's interview. It throws light on what might be called the larger politics of power development. Conflicting claims of navigation, irrigation and power rights in a river system but presage "the medley of local clashes and federal oversights" which will be ushered in by the development of transcontinental arteries of power transmission. It is significant that America's foremost engineer, a member of the Federal Administration, should revivify one of the oldest American forms of compact between commonwealths. "Mr. Hoover talks like a man," says Mr. Hard, "about interstate treaties. He talks like a boy about making a dam in the Colorado River."

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ogy more striking and, for a certain aspect of the case, more exact. Mr. Hoover has spoken of it in the following sentence:

"The growing inter-connection of existing power systems, and their reinforcement with large centralized production units will serve to further assure to the productive industries a stability of their power to a degree of importance that can be compared only to the relation of our Federal Reserve System in the stabilizing of credit."

JUST as through the inter-connecting of credit in federal reserve banks a greater fluidity of credit is achieved, to meet the varying local peak-load demands of industry for finance, even so, through the inter-connecting of electrical force over great areas in great "pools" a fluidity of that force is achieved to meet the varying local peak-load demands of industry for power; and with the increased fluidity there comes in each case, whether it is the case of finance or the case of electricity, an increased industrial stability and steadiness.

"Inter-connection" and "central generation"—these two ideas are for Mr. Hoover the pivots of the idea of "giant power"; and to make those pivots operate there has to be a great deal of political inter-connection between local communities and between states and there has to be, by one device or another, a great deal of centralized political planning.

This planning, in Mr. Hoover's view, may be of very different patterns in different parts of the country. In the southwest, where seven states were contending over the utilization of the water of the Colorado River, Mr. Hoover favored and negotiated the seven-state treaty, which now has been ratified by all the states concerned except Arizona. In the northeast, where the state of Maine has endeavored to prohibit the exportation of electric power from within its borders, and where the state of Connecticut has endeavored to prohibit the importation of electric power from outside its borders, and where Governor Smith of New York and Governor Pinchot of Pennsylvania have views which are in conflict, Mr. Hoover has followed a policy which most observers believe to be headed not so much toward an inter-state treaty as toward an attempted uniformity of state legislation.

OUTRIGHT complete immediate federal regulation Mr. Hoover does not seem to have pressed in any degree which would minimize local responsibility and undermine local initiative. The centralized planning which Mr. Hoover has in mind would not imply a monopolizing of it by Washington. On the contrary it would retain the fullest feasible measure of local planning within states and between states in the several regions in which "inter-connection" and "central generation" are now moving forward to new enlarged phases.

Mr. Hoover has been no great enthusiast for pushing centralization of political control—or, for that matter, centralization of engineering management—beyond the limits dictated by manifest necessity. He has expressed the view that when the managers of a power enterprise are men living immediately among the people who are served by it a situation exists which he would not artificially change. He similarly has not yet summoned the federal government to coerce the states of Maine and Connecticut by any new federal regulatory agency. He hopes that in the northeastern region an accomodation may be reached by the states themselves.

He has reason to realize certainly that such accomodations are naturally not easy. In the case of the Colorado River a long process of popular education was necessary as a preliminary to the actual negotiations themselves. Hearings were held in every part of the Colorado basin. Ranchers who thought in terms of little orchards and industrialists who thought in terms of millions of kilowatt-hours came in to testify and to recriminate and to claim and to concede. By the time the hearings were concluded the men and women of the Colorado basin had a knowledge, a new understanding, of their river and of its mighty power for cooperative good if the claims upon its waters by individuals and by states were modified by concessions to the composite future of the whole region.

In Mr. Hoover's view such processes of popular enlightenment for common sympathy and common action are the surest guarantee of solid success for the actual conduct of the ensuing enterprise. In the case of the Colorado River the negotiations which came after the hearings were greatly facilitated by the improved spirit which the hearings had evoked. Even then, and at that, there was need of long seclusion and many cigars for the negotiators.

ASSEMBLING at a lonely spot near Santa Fè in New Mexico, and representing the varying interests of seven commonwealths extending a thousand miles from north to south and twelve hundred miles from east to west, they talked for day after day till the cigars gave out. Re-equipped then with a new supply of cigars sent out in haste from Santa Fè, they talked and talked for further day after further day until every man had told his tale so many times that he himself could see no variation in the next telling.

Out of their clashings and meetings of mind Mr. Hoover then put down on two sheets of paper the terms of an agreement; and shortly afterwards the negotiators were on their way to Santa Fè, where, with relief as well as joy, the agreement was signed.

Six states—California, Nevada, Utah, Wyoming, Colorado and New Mexico—have ratified it. Arizona has hesitated in view of a provision which gives to agriculture a priority over power-production in the use of the Colorado River flow. Interests in Arizona feel that for Arizona the matter of power-production is more important than the matter of agriculture. Thus one state might check the full consummation of a great regional project.

Time, however, is the one thing of which it may be said that no matter how much of it may be lost there is still an endless supply of it. Local self-government, on the other hand, and the talent for local self-government, which is the root of all secure nationhood, when once lost, is lost not merely for the moment but for a long future and, if ever regained, is regained only after cataclysms of inward disaster and of outward effort. It is a commonplace of history that we occupy this land of ours, instead of its being occupied by our predecessors the French or the Spanish, largely because we slowly advanced on the lessons of our own mistakes while they rapidly rose and declined on the energy and then on the ignorance of their distant national governments. The city of Washington, which knows most about the inward workings of federal centralization, would rather wait many years for voluntary action by Arizona than impose upon it

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a federal mandate which would bear the usual crop of consequent runnings to Washington for the settlement of disputes not only of large bulk but also of federally unintelligible local pettiness and capable of true settlement only by local neighborly counsel.

SIMILAR considerations arise in the matter of the regulation of the rates charged and of the services rendered by the light and power corporations which now presently will be inter-linking themselves by an ever larger and ever thicker network of wires across state lines. The corporation which has been serving a locality expands itself to serve a district. The technique of the transmission of electrical force improves; and the corporation is able to supplement its supply of its product by establishing a production plant at the mouth of a distant coal-mine or water-fall. It then expands still more in area served and by and by it even today is able on the Pacific Slope to establish interconnections which take it from near the border of Mexico to near the border of Canada. It is then extremely interstate and yet there is no convincing proof that local regulation has failed to elicit from it a competent degree of serviceableness.

Questioned on this point, Mr. Hoover while not committing himself to any ultimate generalizations, pointed out that electric power is almost unique among commodities in that it is now for the most part being sold at approximately the same level of prices as existed for it previous to the recent great wave of price advances. Regulation, it is to be remarked, does not seem to have discouraged technical initiative in the electric industry. Regulated by tirelessly pursuing hordes of regulators, the electric power industry has not lain down to be squeezed and impoverished in the tracks of its existing proficiency but has risen to its feet and has fled down the road to improved methods and to increased profits at least one year ahead of its pursuers who forever are transmuting those profits into lower rates.

It has been a case of a regulatory order for more cheapness of rates, followed by technical improvements yielding more cheapness of production and a bulge in profits, followed in turn by a new regulatory order diminishing the profits and necessitating new technical improvements if any new increased profits were to be made before the regulators again caught up with the fleeing engineers.

IT is true that the states differ among themselves in methods of regulation. It is true that harmonious action between states in the matter of regulation, as well as harmonious action between states in the matter of the use of river flowage and in the matter of exporting and importing of power across state lines and in the matter of the taxation of power, may become increasingly necessary, through interstate treaties or through uniform state statutes, in proportion as technical improvements produce new and enlarged possibilities in central generation and in inter-connected long distance transmission. It is also true, however, it is believed, that if our thirteen original states could unite of their own free will in the making of the Constitution it will be possible for groups of states to unite in the reaching of understandings about the single subject of electric power without calling upon the federal government to intervene in details which at this moment require decisons not country-wide but only regional.

THREE functions indeed for the federal government are disclosed by its positive power over navigable streams, by its negative power over inter-state agreements and by its superior strength in the obtaining of financial investment credit.

As the immediate sovereign over all navigable territorial waters of the United States, whether those waters lie along the sea coast or extend inward into the territories of the several states of the Union, the federal government is obliged to undertake the responsibility of permitting or of preventing the erection of dams and of accompanying power plants in streams to which the attribute of navigability is conceded by the facts or, at any rate, by the courts. With this responsibility there comes naturally the further responsibility of seeing to it that such dams and such accompanying power plants are erected in harmony with the general public interest and in harmony accordingly with some reasonably comprehensive plan of ultimate complete "giant power" development.

The second federal function here indicated springs from Article 1, Section 10, Clause 2, of the Constitution, wherein it is stated that "no state shall, without the consent of Congress, enter into any agreement or compact with another state." Inter-state agreements therefore in the matter of electric power cannot come into binding force without federal permission; and it would seem to follow that this permission should not be granted unless the agreements in question conduce to the public welfare by being in harmony with a well-considered electric power development program.

Mr. Hoover's work as chairman of the Colorado River Commission has been an illustration of the constitutional necessity which rests upon the federal government in the sanctioning, and therefore in some degree in the supervising and molding, of agreements between states for any purpose, including the purpose of the utilization of river flowage whether for irrigation or for the manufacture of electricity.

These first two functions of the federal government in relation to "giant power" development are necessitated directly or indirectly by the Constitution itself. The third function would be purely voluntary.

Mr. Hoover in conversation has pointed out the possibility of great economies in the federal financing and federal physical building of waterpower electricity production plants. He has pointed out that the government could pour concrete for dams and for power-houses as economically as it could be poured by any other owner, letting the work to a contractor, and that in borrowing the money for these colossal construction works the federal government could by means of its superior credit strength save many millions of dollars in interest charges.

Having completed the works, it could lease them at a regulated rental per unit of water to power corporatons which in their charges to the consuming public are regulated by local authorities. The construction economies achieved by the government could thus in no case be retained by the power corporations but in immediate consequence of the incessant activities of the local regulatory authorities would be passed on to the pocket-books of the consuming public in lower rates.

MANIFESTLY while the engineer is engaged in causing electric currents to travel unimpaired over longer and longer lengths of wire he is producing a political

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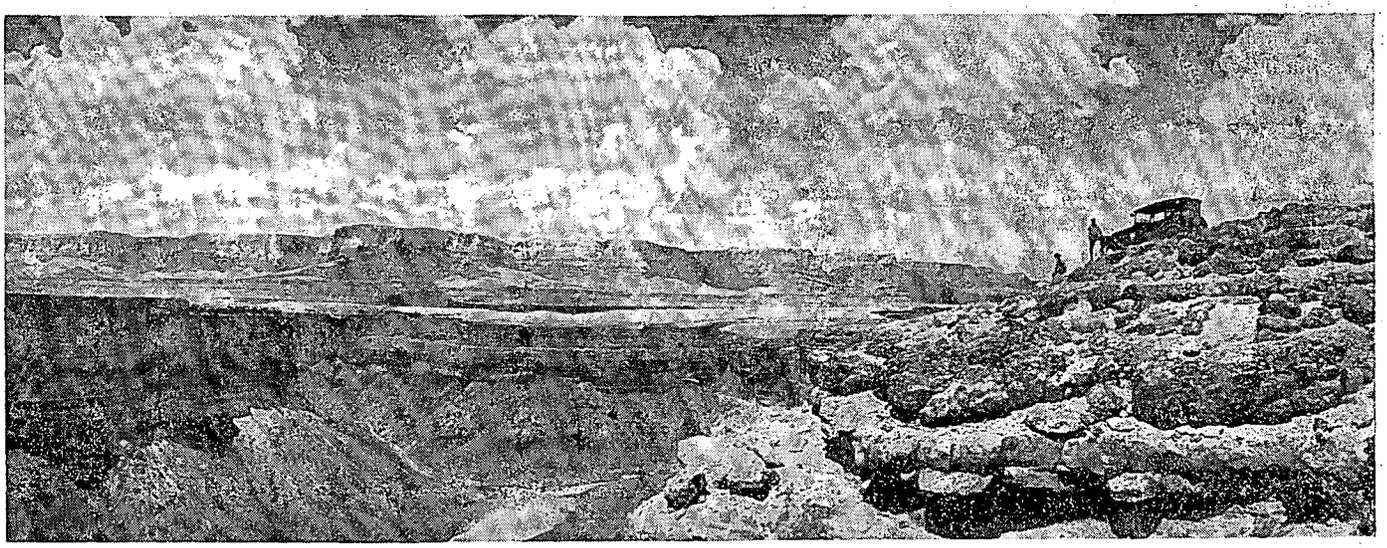


The vagrant Colorado river, left to its own devices, turns sculptor and with erosion carves its picturesque way through the solid rock. What it does vertically through the strata, it does horizontally through the political institutions of its most recent masters. Seven states were involved in the Colorado river negotiation

situation which, with its medley of local clashes and of federal oversights, and with its adjustments of one sort in one part of the country and of another sort in another part of the country, will open up a new and most complicated set of relationships between state and state and between groups of states and Washington.

In the negotiations leading toward those relationships Mr. Hoover has borne, and is bearing, a leading part; and yet it is not in them that he, or perhaps any one else, can find romance.

He discusses them with an intelligent cold eye upon their outcome in social usefulness.

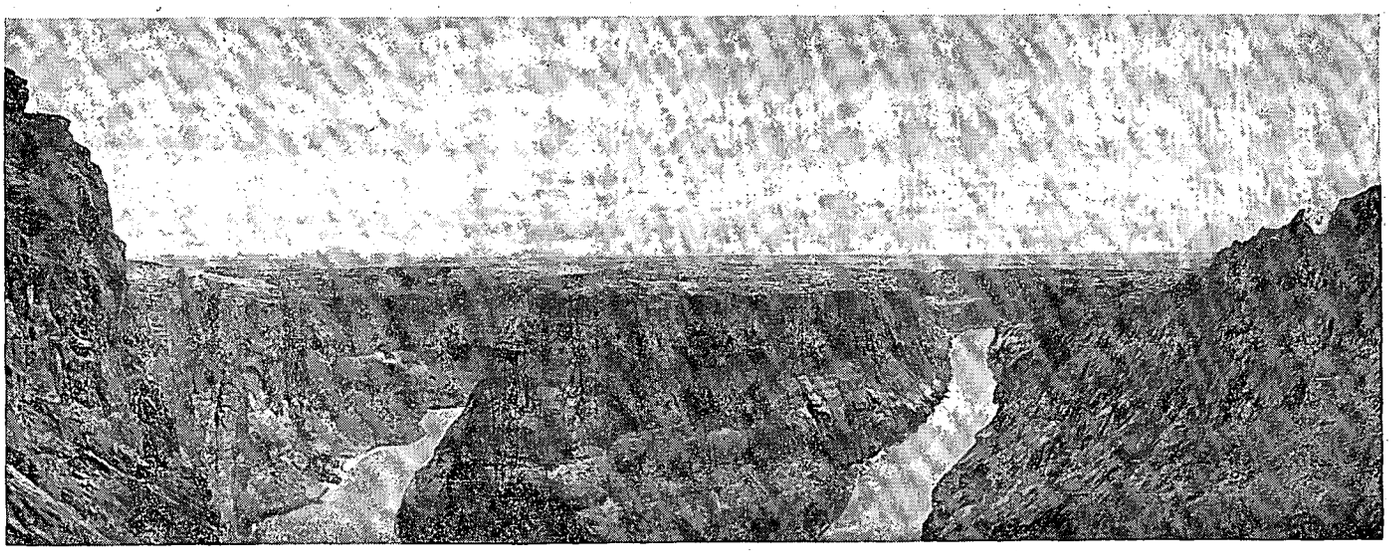
Social usefulness is a derived duty. Piling boulders into a brook to make a swimming pool is a primary duty of the boy for whom manhood will not make the world grow old. Mr. Hoover talks like a man about inter-state treaties. He talks like a boy about making a dam in the Colorado River.

He will make it go down one hundred and sixty feet below stream bottom. He will make it rise two hundred and fifty feet higher than the Washington Monument. At stream bottom he will cause it to be perhaps six hundred feet wide. At its top he will cause it to be perhaps twelve hundred feet wide.

In order to make ready to build it he will dig eight tunnels through the adjoining cliffs. Some of these tunnels will be a mile long.

Through them he will cause the Colorado River to flow out of its bed and to yield to him a dry place on which to get his dam built before he turns the Colorado River back to its accustomed course and sees behind the dam the waters rising to make a lake which will give to distant sands, sunk below sea-level in the Californian Imperial Valley, a secure fertility and beauty.

And perhaps, somewhere, in some really accessible canyon, he will build a waterfall.



The engineers dealing with the Colorodo river project will, by tunnelling sometimes a mile or more, turn the stream aside until dams are built to conserve the water and harness the temperamental waters to permanent usefulness -- then they will restore the river to its natural course

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National Electrical Highways

By PHILIP CABOT

As a banker and public utility operator, and from long time association with the investment security house of White Weld & Company (New York and Boston), Mr. Cabot writes from ample experience in the financing of power corporations. He visualizes high tension electrical transmission as the "logical next step" of a privately owned public utility, which has its roots in local enterprises and has the history of the railroads as a precedent and forewarning.

He projects "a structure like a system of national highways connecting the great cities in the several states, from which radiate the local roads to the farms and villages under local control." He would rigorously separate both in corporate identity and government regulation the interconnecting high power transmission companies from the local distributing systems and central stations; put the former under federal license to sell power to the latter and only to them; leave to the states rate and service regulation of power sold by the latter to the consumers; and thus avoid "the multiplicity of conflicting controls."

WE see in these days repeated reference in newspapers and magazines to what is called a super-power or a giant power system, by which the authors mean a system of high tension electrical transmission linking together the central electric generating stations of a group of States; the group along the Atlantic seaboard and the Appalachian and Allegheny water sheds, for example.

As phrases to interest children these words are good, but as instruments of political propaganda they are unfortunate because they raise a false image in men's minds and set them wandering after strange gods. In the mind of the average man they raise a picture of something supernatural or gigantic, a sort of Jack the Giant Killer thing, while the development that is proposed is nothing of the sort. This distinction is an important—perhaps *the most important*—fact in regard to this project at the present day, for from its springs the hope that we shall live to see this idea transformed into a tangible thing of steel and copper doing its work in a worthy, workmanlike manner.

The theory and method of high tension electrical transmission for long distances is thoroughly understood and has long been practiced. The development now proposed involves nothing magical or novel. It is merely the logical next step in the national growth of a public utility which has been going on for fifty years.

IN the beginning, private individuals installed little electric generating plants for their own use. Then they began to supply a few neighbors. Lighting of a group of houses and the public streets from little central stations supplying direct current came next, and with the discovery of the alternating current, the use of higher voltage enabled these systems to spread. Small power loads were taken on. And so the thing has grown.

It is not necessary to trace the whole process in detail. We are all familiar with it and the only point that requires emphasizing is that it has followed the lines of normal economic growth with the ponderous and irresistible movement of a glacier in spite of the frequent folly of promoters and capitalists on the one hand and the occasional political unwisdom of legislators on the other. The advance which is now imminent will come, but it can be retarded or hastened by political action.

In the point of development where we now stand the small isolated plant and the small central station have almost disappeared, being absorbed by large central stations from which alternating current at high voltage is sent out to substations 50 or 100 miles away, where the voltage is reduced to a modest pressure and all the needs of the local communities for light, heat and power are supplied. In some parts of the country current is now transmitted 200 or 300 miles. The business of these central stations and distributing systems is not as a rule interstate business. The majority of them are confined to one or two states under control of state regulating commissions which fix rates and conditions of service. Interstate commerce of this character is not now extensive, but as the next step in advance will make it so this feature is the most critical of all. If it be wisely dealt with progress will be sound and rapid; if not, progress may be long delayed.

TWO dangers confront the promoters of this advance. They are like Scylla and Charybdis menacing the passage on either hand and we must avoid both or come to grief. For the sake of brevity these dangers may be earmarked as Absent Landlordism, and Over-regulation.

As I have said, the business is now mainly of a local character, under the control of State Commissions, by which the rights of the small consumer are jealously protected. But as the system expands over groups of states there is danger that the local character of the industry may be lost. There will be a tendency to combine the local companies either by merger or by the intervention of holding companies, so that the individuality of the local companies will be lost. If it is, the little people will suffer. It is essential, in my judgment, that the identity and local control of the present companies shall be preserved, in order that the small consumer may get adequate attention. As a matter of fact, he is the best customer which the companies have, but this has not always been recognized. In some states this has caused anxiety to governors and regulating commissions.

IN some communities the companies have failed to give him enough attention on the plea that it is unprofitable to serve him. This is far from being true; the fact is that he is the most profitable customer of all. And this is easy to prove. The great power customer can make his power and deliver it at his machine as cheaply as the central station, and even the smaller power user can do it for 25 per cent or 30 per cent more. This class of business, therefore, is

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highly competitive and must be taken at a very small margin of profit. But the householder, who wants electricity for domestic uses, cannot, in most cases, produce it for himself at any price, and even when he can it costs him 200 per cent or 300 per cent more than the central station. As a result, this class of customer can and will gladly pay the company a handsome profit to serve him; ten times as much in many cases as the large consumer.

As an answer to the problem of the small consumer this should be answer enough, but there is another and even better one.

The average retail business in which most men are engaged turns its capital from three to five times a year, so that a small profit on the turnover makes a handsome one on the capital, and such a business can weather without serious damage the periodic financial storms which follow the change of the trade winds known as "the business cycle." But the public utility companies, far from turning their capital five times a year, rarely turn it once in five, so that for them wide margins of profit and great stability of business are vital. Of these essentials the great power customer gives neither, and the householder gives both. Whatever the terms of the written contract the great manufacturer will not pay for power which he cannot use. When his mill is closed by depression or by strike he will not and often cannot pay for power which is not supplied. His payments to the companies, therefore, are subject to violent fluctuations, although his price is very low. This is exactly the condition which is most disastrous for the public utility companies, with slow turnover and great fixed charges.

But with the householder the exact opposite is the case. He *must* light his house, cook his dinner and wash his clothes year in and year out, whichever way the wind blows. His demand is amazingly constant and he pays a high price. In fact, if you plot the curve of his demand you can hardly detect in it the periods of financial depression which make the curve of the power customer look like the Rocky Mountains.

These facts are widely known and commonly acted upon, and it may safely be assumed that so long as the management of the companies is local they will be recognized and acted upon. For the corporations, with all their sins upon their heads, do not lack the shrewdness of the market place. In some cases and for a time managers may be dull or overworked; the small customer is often cantankerous and his name is legion; much good temper and great administrative ability are required to deal with him. But money talks, and you get these things when you pay for them.

But if the local character of the distributing companies be lost, the small consumer will be in danger, and in framing a system to regulate this new form of interstate commerce implied by such terms as Giant Power we must guard against that danger. It can be avoided and I shall try to suggest a way.

THE next step to be taken is the connecting of all the great central stations on the Atlantic seaboard, for example, by a system of high tension transmission which shall make possible the most economical generation of the power by coal, oil and water and its most economical distribution.

Glance for the moment at the economies which will result. The central station capacity required to serve the States along the Atlantic seaboard and on the Appalachian and Allegheny watersheds is not known, but I hazard the opinion that not less than 15,000,000 horsepower will be required. Each one of these central stations, *as they are now operated,* must keep in reserve at all times one generating unit equal in capacity to the largest one in use in order to protect its service against accidental interruption. In practice this means that about 25 per cent, or 4,000,000 horsepower of station capacity, must always stand idle. Taking $150 per hp. as fair value of this investment, we find an idle investment of about $600,000,000 on which the public must pay fixed charges. If these stations were connected through a transmission system of adequate capacity and scope 80 per cent of this idle investment could be eliminated. Right there you save nearly $500,000,000.

And again, two things are necessary for high efficiency in a central station—cheap fuel and abundant cold water for condensing purposes. In New England this means a location on tide water and of all our central stations of large capacity only three are so placed. All the other stations are located on ponds, rivers or shallow tidal estuaries, where condensing water is warm and insufficient for a great station and coal rates are high. An adequate transmission system would eliminate them.

And there is another great economy which would be made possible. In all the streams of the Appalachian and Allegheny water-sheds the runoff varies greatly in different months of the year, the low flow in many cases being only 1 per cent of the maximum. Often this condition could be improved by storage reservoirs, but in a country so thickly settled these would be expensive and they have not been built. The result is that no profitable development of all this water power can be made which will utilize one-half of the water available. The rest goes to waste. But with a great interconnecting system and the market for power which would result, many billion horsepower (hours) could be generated almost without cost for investment or operation.

AND then consider the railroad situation. A large fraction of all the bituminous coal used in the country is burned under locomotive boilers in furnaces which are the most wasteful of any now in use and fired with the utmost inefficiency. Two-thirds of this coal is almost literally wasted, but it forms a large proportion of the ton miles which the railroads handle because it is all hauled twice over the road, once from mine to storage yard and again in the locomotive tender. The waste of fuel, labor and capital in this operation is prodigious, and would have been stopped by electrification long ago had not the financial collapse of our railroad system made the expenditure impossible.

These are not all of the possible economies but they are enough to indicate their nature and the importance of achieving them. Considering the magnitude and variety of the economies which a comprehensive system of high tension electric transmission would produce, it may seem incredible that it is not here today. But as in all other cases there is a reason.

The collapse of the railroads and the flight of capital from this field has been directly due to an unwise system of public regulation. The railroads are subject not only to the Interstate Commerce Commission but to a local commission in every state in which they operate. Some of them have a dozen or fifteen masters whose chief aim has been to repress them, in which aim they have so far succeeded that the roads are wellnigh dead. Such a transmission system as

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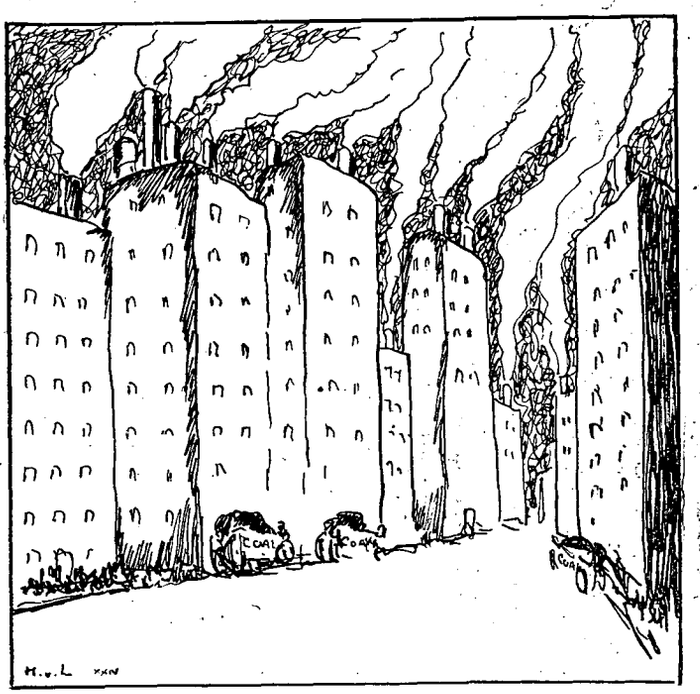
is needed for the economical development of our electric power supply would be an interstate public utility exactly like a railroad, and the fear of regulation on the railroad pattern is the chief obstacle to progress today. Capitalists are human in spite of appearances, and therefore are never wholly self-conscious. They often do not know the real basis of their fears and in this case this obstacle has not been wholly visualized by promoter and banker, but it is the real one none the less. For this reason our most important duty at the present time is to think out clearly and embody in appropriate legislation a system of regulation which will regulate and not destroy.

THE one great lesson which two generations of railroad regulation should have stamped indelibly upon our minds is that, provided the public interest is safeguarded, the less regulation the better. Over-regulation has ruined the railroads. Let that lesson be taken to heart. And if it is, the outlines of the method of transmission line regulation are fairly clear. These companies should be placed under the *exclusive control* of a federal commission and the power over them of that commission should be limited to the question of whether any particular projected line should be built nor not. In other words, the whole duty of the commission should be to issue a certificate of public necessity or to refuse it. The transmission companies must have the right to take land for line and substation purposes in any jurisdiction provided such a certificate has been procured, but they should be forbidden to sell power to any individual or any corporation except public utility corporations under the control of a state, utility, or railroad commission, and they should be forbidden to control the local companies. In this way the transmission lines would be given the clearest and simplest status consistent with the public interest and their development would not be hampered by a multiplicity of conflicting controls, while the States, on the other hand, would retain all the powers of rate and service regulation which they now have unimpaired by the conflicting jurisdiction of the Federal Government. If such a method as this be mapped out at the present time the development of comprehensive interconnecting transmission systems will proceed as rapidly as the public interest requires.

THE gas, electric light and power companies of the several states now cover, or can be required to cover, the whole field and serve every solvent customer, so that there is no occasion for the transmission companies to go into the retail distribution business. This should remain with the local companies, where it is now.

Of course, this method of regulation will not eliminate the silly protectionism which sometimes induces a state to forbid the export of power, but no system of law will. Time alone can cure this evil and it must be allowed to.

What will come is a structure like a system of national highways connecting the great cities in the several states, from which radiate the local roads to the farms and villages, under local control. So the *national electrical highways* will connect the great central stations from which radiate the local distribution system which the states control. These electrical highroads should be chartered as toll roads under private ownership and management, because they serve only a minute fraction of the whole people, namely, the public service corporations. By the use of this method those who use, pay, and those who don't, escape, or think they do, which is the same politically.



Drawn by Hendrik Willem Van Loon

American city: reproduced from the archives of the Early Twentieth century

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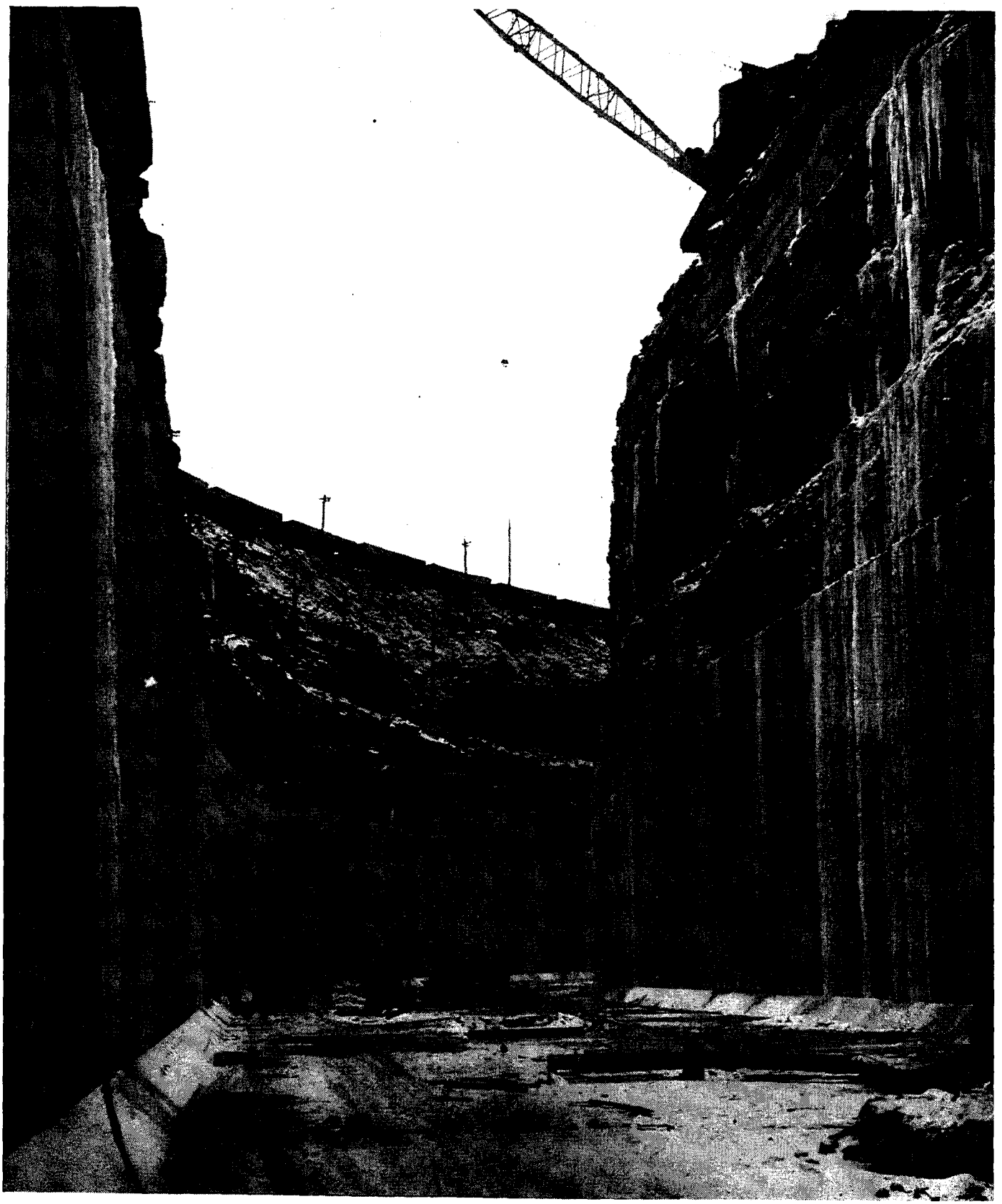

QUEENSTON-CHIPPAWA DEVELOPMENT CANAL, AT LUNDYS LANE CURVE, WHERE THE BOTTOM OF THE CANAL IS 143 FEET BELOW GROUND LEVEL

SEVENTEEN million cubic yards of rock and earth have been excavated and the canal is lined throughout with concrete; not less than 450,000 cubic yards of concrete have been used altogether on the whole project. Several bridges have had to be built, to accommodate a number of important railway lines and highways intersected by the canal. Eighty-two miles of standard gage construction railway track were laid to handle excavated material and the majority of the locomotives used were electrically driven. Many large shovels, five of them being the largest in the world and electrically operated, were employed; each of these five shovels could load a car of 20 cubic yards capacity in one and a half minutes

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Ontario's Experience

By SIR ADAM BECK, Kt., LL.D.
Chairman of the Hydro-Electric Power Commission of Ontario

THAT more than 380 municipalities acting cooperatively have invested about $250,000,000 in a common undertaking for the distribution of electrical energy to their citizens, that this organization has been in successful operation in Ontario for nearly fifteen years and that it is accumulating large financial reserves while supplying electric light and power over extensive areas at unprecedentedly low rates, are facts which have attracted world-wide attention.

In its essence, the "Hydro" electric power undertaking of Ontario is an organization of a large number of partner municipalities, coordinated for securing common action through the medium of the Hydro-Electric Power Commission which acts as their trustee. As such, the Commission generates or purchases electrical energy which it transmits to the associated municipalities. Each year it allocates the entire cost of operation of each system among the respective partn r municipalities, so that these contribute each its own proper and proportionate share towards the cost of operation. Each municipality owns its local distribution system and distributes the power to its individual customers. These individual customers, in turn, are charged rates which will meet the cost of power furnished to the municipality by the Commission, together with the cost of operation and management of the municipal distribution system.

ABSENCE of coal resources in the province, advances in the art of transmitting electricity, and recognition of the manufacturing potentialities of the country, were the three chief factors which, about 1900, prompted a number of leading manufacturers in southwestern Ontario to look into the possibility of obtaining hydro-electrical energy at rates cheaper than the cost at which power could be generated locally from coal, gas or oil.

It was realized that if the large water-power of the Niagara River could be used as a basis for the widespread transmission of electrical energy throughout the more populous portions of Ontario, then importations of coal could be substantially reduced and Ontario would, thereby, be rendered less dependent upon foreign resources. Interest in Ontario's power problem was greatly stimulated by public meetings, and discussions in the press. Appeals were made to the provincial government for legislation, and finally, as a result of the general movement, the government of Ontario, in 1903, provided the means by which a commission could be appointed by interested municipalities to investigate the generation and distribution of hydro-electrical energy. The authority thus granted resulted in the appointment by the municipalities of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph, of the Ontario Power Commission, which after a thorough investigation, published a comprehensive report in 1906. When the results of this investigation became known, the provincial government, that same year, provided by special act for the creation of the Hydro-Electric Power Commission of Ontario, the organization now in existence. With the exception of the chairman, the personnel of the Commission has changed from time to time, but it is noteworthy that the services of many of the Commission's most important officers commenced with its creation and—notwithstanding several changes in the governments of the Province—they are today in responsible charge.

In 1906, by-laws were passed by thirteen Ontario municipalities authorizing their Councils to make contracts with the Commission for a supply of electrical power from Niagara Falls. In 1907, further legislation strengthened and extended the powers of the Commission. One essential difference between the act of 1903 and those of 1906 and 1907 is, that under the former various municipalities could combine into separate groups operating through separate commissions, whereas under the later acts all municipalities make their wants known to the provincial Commission which is then able to harmonize their various requirements and coordinate the municipalities into groups or districts.

A Remarkable Municipally Owned Enterprise

WHEN Sir Adam Beck complied with the request of the editors of The Survey for an authoritative statement on the work of the Hydro-Electric Power Commission of Ontario, we counted ourselves tremendously fortunate. For here is an agricultural and manufacturing region—without natural coal resources—which has developed energy from rapids and waterfalls as has no other district in the western hemisphere. Here the issue of public control and development has been removed from the realm of theory to that of practical results; to be weighed and judged thereby. Here hamlet and countryside as well as factory center have felt the stirrings of a new day; and, moreover, here the city, town, village and smaller municipality have borne the work of constructing and operating a vast hydro-electric undertaking on a cooperative basis. Sir Adam sets forth from the standpoint of the Commission how 380 such cooperating municipalities receive electric light and power "at cost" and own or are constructing plants capable of an aggregate development of a million horsepower.

THOSE entrusted with the formulation of the policy to be pursued by the Commission were impressed with the underlying strength of the industrial and commercial possibilities of the territory seeking the cheaper power and light. Southern Ontario, the area served by electrical energy from Niagara, lies approximately between latitudes 42 and 44. The greater part of this area is further south than much of northern New York state, than the larger portions of the states

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of New Hampshire, Vermont, Michigan, Wisconsin, Minnesota, South Dakota, Idaho and Oregon and than the whole of the states of Maine, North Dakota, Montana and Washington. Compared with Europe the area lies in the same latitude as the south of France. The Province has many climatic advantages. That precipitation throughout Ontario, both in amount and in its seasonal distribution, is sufficient for agricultural purposes and is an asset of prime importance. The whole Province is well watered and with its many streams and lakes replenished from the annual precipitation, the water power developments are in most instances exceptionally well protected. Its agricultural advantages for mixed farming and fruit-growing are well known. Its railway and inland facilities are excellent. In all the large municipalities, the employer of labor contemplating the establishment of new industries may count upon adequate transportation facilities, unsurpassed educational and social conditions, and standards of living and of administration of public affairs equal (in many cases superior) to those to be found elsewhere.

From this brief consideration of the natural advantages of the Province it will be appreciated that with Ontario's background of agriculture, its timbering, mining, fisheries and game, there are available supplies of raw materials for an extensive manufacturing industry with marked possibilities for increasing exports from farm and factory. Such circumstances, then, constituted a solid foundation of great promise upon which the Commission could build in establishing a market for the consumption of electrical energy for domestic, commercial and manufacturing requirements.

THE lines along which the Commission has conducted its work are easily grasped.

If the people of a municipality want to obtain a supply of power, a vote is taken at the polls, and an enabling by-law passed whereby the municipality may contract for it with the Commission. The Commission's engineers are at the service of the municipality for the purpose of making an estimate of its requirements. The contract having been executed, a money by-law must also be passed by the electors authorizing the municipal council to issue the debentures necessary to cover the cost of constructing a distributing system within its limits. The Commission thereupon proceeds with the work of building up the necessary transmission lines, sub-stations, etc. The municipalities repay the cost of the project out of earnings, spread over a period of thirty years; all such items as maintenance, depreciation and sinking fund being fully taken care of. At the end of thirty years' time the entire plant and equipment will have been paid for, and the people become the owners of a fully-paid-up undertaking.

The basic principle of the whole "Hydro" project is a partnership of municipalities formed to obtain electrical energy at cost, each municipality paying its proportion of the cost for the service received. The Commission, acting as trustee and agent for the municipalities, exercises both administrative and constructive functions, and has evolved a well-defined and successful working policy for the development, transmission and distribution of hydro-electrical power under municipal ownership.

The fundamental basis on which power is supplied is that it must be sold "at cost," but not every one is aware just what is meant by this term. "Cost," so far as "Hydro" power is concerned, includes all charges arising out of the generation, transmission and delivery of power to the municipalities. These charges include, for each municipality, its share of the interest and sinking fund for the cost of lands, stations and equipment required for supplying power as well as a proportionate part of administration, operation, maintenance, renewal, insurance, and all other costs entering into the business of supplying electricity.

Sir Adam Beck, Chairman since its inception of the Hydro-Electric Power Commission of Ontario

The framework of the financial structure of the Hydro-Electric Systems may be set in a few concise statements:

First: The generation and transmission of power on a wholesale scale is dealt with by a Commission which, although appointed by the government of the province, acts independently in the capacity of trustee and agent for the partnership of municipalities.

Second: The local distribution of electrical energy within the borders of a municipality is, in general, under the administration of a public utilities commission appointed under the provisions of the Public Utilities Act.

Third: Capital required for the plant for the generation and transmission of power is provided by the Government upon receipt of formal requisition from the Commission. Contracts are entered into between the Commission and the municipalities under the terms of which the mu-

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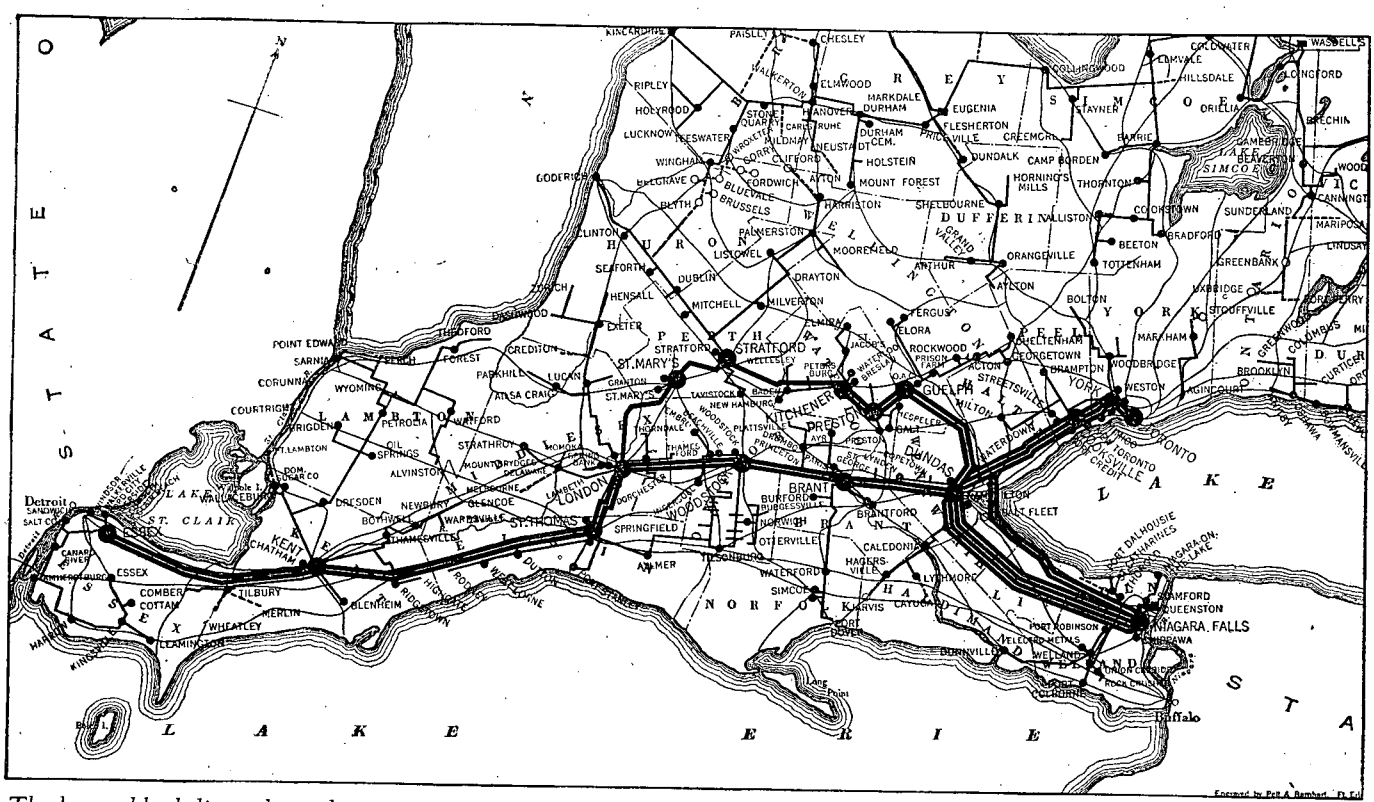

The heavy black lines show the power transmission system with its source at Niagara Falls, municipally owned and operated under the Hydro-Electric Power Commission of Ontario, Canada

nicipalities undertake to repay in thirty years the monies thus loaned by the Government.

Fourth: The local distribution system is financed by the issue of municipal debentures. Provision is made in the rates charged to the ultimate consumers, for revenue with which to retire these bonds also, usually in twenty years.

Fifth: The "Trustee" Commission supplies power to the municipalities, charging each municipality the actual cost. To do this, an interim charge is made monthly based upon the estimated cost, and, at the end of each year, credit or debit adjustment is made of the amount charged, in order to make up the actual total cost—no more and no less. The "cost of power" includes all the usual costs of operation and maintenance of the generating, transforming and transmission plant and equipment, and, in addition, the annual interest charges on the monies borrowed for the initial cost of installation, also provision for renewal (depreciation) and sinking fund reserves, as well as a special reserve fund for contingencies.

Sixth: Each municipality sells electrical energy to its local consumers at rates and under conditions approved by the Commission. The rates charged to its consumers by a municipality are sufficient to take care both of the cost of distribution within the municipality and of the estimated cost of power to be paid to the Commission by the municipality. The cost of distribution is ascertained in a manner identical with that used by the Commission in arriving at its wholesale costs.

Seventh: Under the Power Commission Act, the Commission is required to determine, annually, the actual cost of service supplied to the municipal corporations by the local commissions for such strictly municipal purposes as street lighting and operating electric-motor-driven pumps in waterworks, and if any profit has accrued through the charging of the rate used throughout the year, this surplus is handed back to the municipal system.

AT the outset of the Commission's work, after studying various sources of power for distribution to the municipalities it was concluded best to initiate their cooperative enterprise by purchase from power companies which had extensive plants already erected at Niagara Falls. Consequently in 1908 the Commission, on behalf of the municipalities, entered into a contract with the Ontario Power Company for the supply of 100,000 horsepower of electrical energy at $9.40 per horsepower-year until a load of 25,000 horsepower should be reached, after which the price was to be $9.00 per horsepower-year. The Commission built transformer stations and transmission lines for distributing the power to the contracting municipalities, and by about the end of 1910 was supplying ten urban municipalities. The small initial load of less than 1,000 horsepower increased until in 1914 it was 77,000 horsepower, and by 1915 the Commission had reached the limit of its contract for 100,000 horsepower. In 1920 the load was 356,000 horsepower. The Commission had arranged meanwhile for additional power supply from the Canadian Niagara Power Company of 50,000 horsepower, and from the Toronto Power Company of over 25,000 horsepower. It subsequently purchased outright the Ontario Power Company with its plant capacity of 160,000 horsepower, and more recently acquired the Toronto Power Company with that of 125,000 horsepower. Finally, in its new Queenston-Chippawa plant the Commission has provided for an ultimate development of 600,000 horsepower.

The extent of the Commission's operations is registered by the fact that the high-tension lines alone in its transmission networks aggregate over 3,000 miles.

The municipalities now own and operate a number of hydro-electric systems, including power plants. These systems are: Niagara, Severn, Eugenia, Wasdells, Muskoka, St. Lawrence, Ottawa, Rideau, Thunder Bay, Central Ontario and Trent, and Nipissing. Of the foregoing, the Central Ontario and Nipissing systems were purchased by the Provincial Government in 1916, their operation being entrusted to the Commission.

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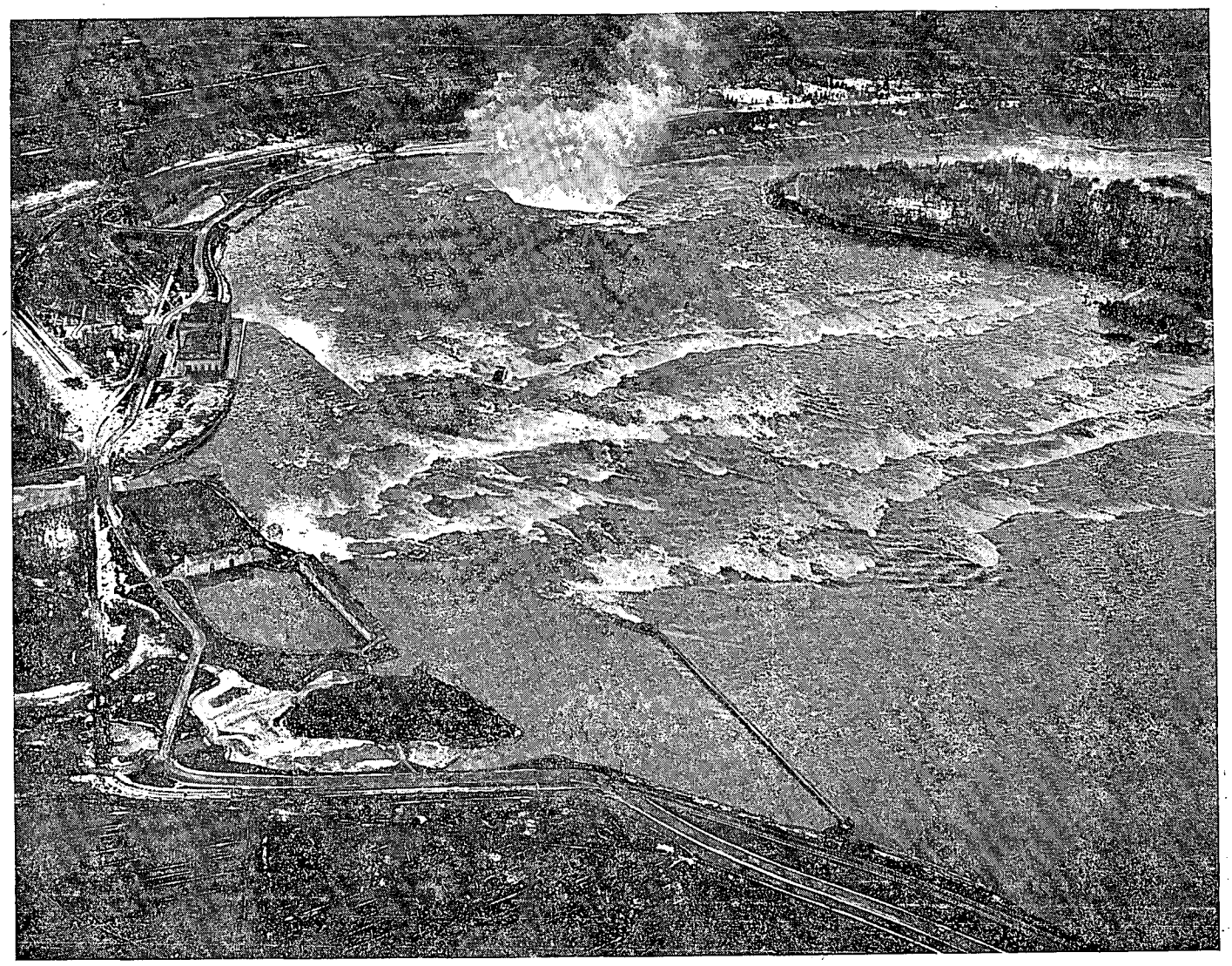

An aerial photograph of Niagara Falls and the "Hydro" country

Since commencing its operations, the Commission has purchased no less than twenty waterpowers, thirty hydraulic generating plants, and over sixty electric distribution systems. It possesses the right to expropriate private plants; nevertheless—with the single exception of a case at present under consideration—the Commission has not required to invoke its powers of expropriation, but has been able to consumate every transaction upon fair terms, satisfactory to the interests immediately involved.

To-day, including exported power, the Hydro-Electric Power Commission of Ontario is distributing about 700,000 horsepower, and operates twenty-one undertakings which, when fully developed, will have a potentiality of over 1,000,000 horsepower.

The province of Ontario is the owner of Canada's equity in the water power in the international portion of the St. Lawrence river; this share amounts to over 800,000 horsepower. It often takes several years to prepare the plans and construct the installations necessary to supply large quantities of power, and those who have followed the phenomenal growth in demand for electrical energy will appreciate that it is one of the functions of an organization like the Hydro-Electric Power Commission to appraise existing conditions in the light of future needs. Present conditions clearly indicate that the power markets will be short of power before the St. Lawrence River hydro-electric power can be made available even though the work were commenced immediately.

THE greatest individual engineering project which the Commission has undertaken is the Queenston-Chippawa power development on the Niagara river. Its general scheme comprises an intake structure in the Niagara river at Chippawa; the deepening and widening of the Welland river between Chippawa and Montrose, a distance of 4½ miles; the construction of a canal 8½ miles long from Montrose to the forebay and screen house at a point on the cliff about a mile south of the village of Queenston; and the construction and equipment of a power house, in the gorge, immediately below the forebay.

Existing power developments on the Niagara river have only utilized that portion of the total fall of the river which occurs in the vicinity of the falls and, for the most part, even this amount of head has been inefficiently utilized. The basic conception of the Queenston-Chippawa development is the utilization of the greatest possible amount of the total fall of the Niagara river between Lake Erie and Lake Ontario at the highest possible efficiency. Of this total fall of 327 feet, about 10 feet occurs in the upper Niagara river from Lake Erie to Chippawa and in the lower river from Queenston to Lake Ontario. These 10 feet it is impossible to re-

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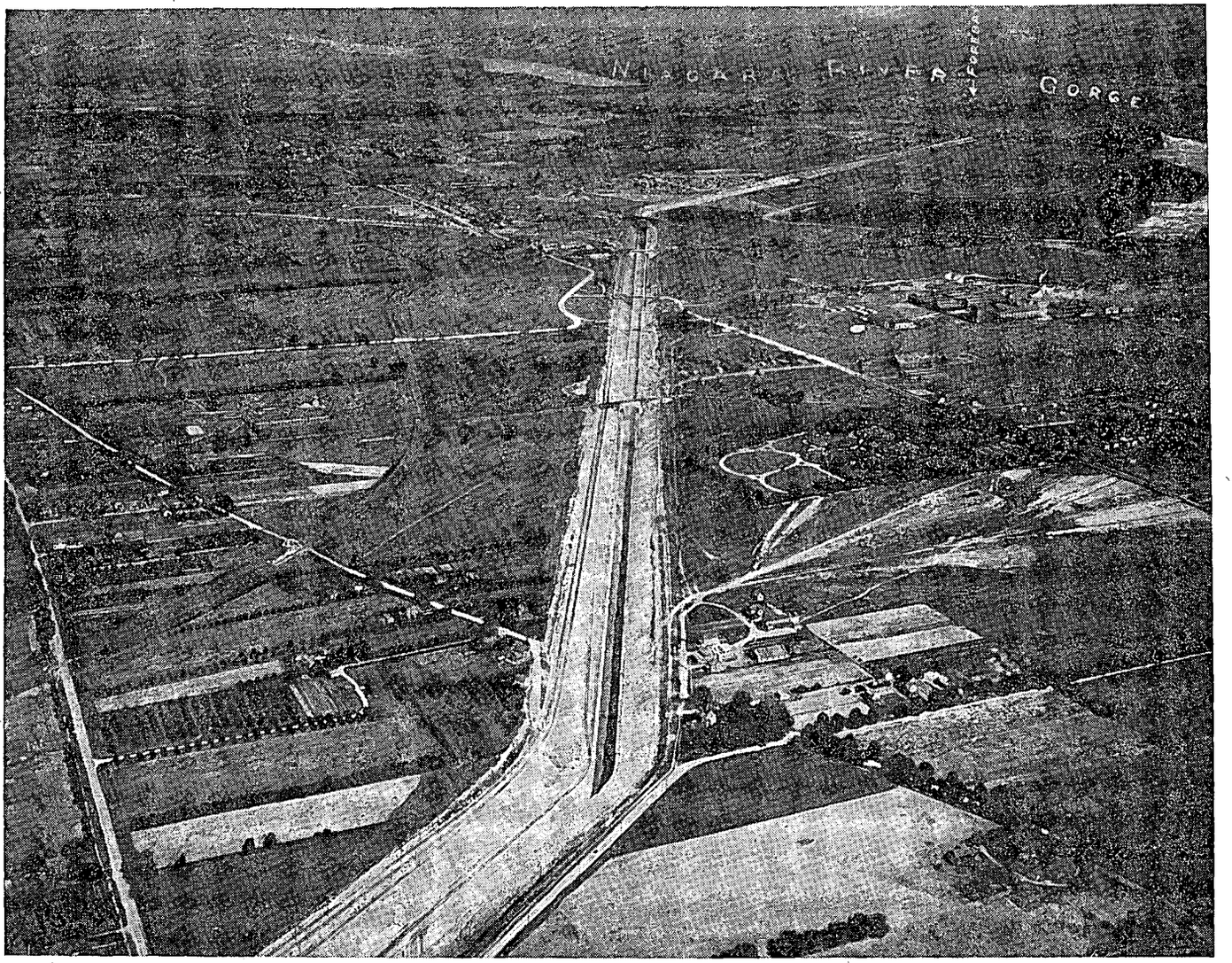

An aerial picture of part of the completed power canal traversing the Niagara peninsula in the Queenston-Chippawa development

claim for power purposes. Of the remaining head, about 12 feet is required to convey the water through the canal.

The average head actually available at the power house is 305 feet, and 30 horsepower is developed for every cubic foot of water that flows through the canal per second. That this is a great forward step in economy is apparent from the fact that only 16 horsepower is obtained from each cubic foot of water flowing per second in the most efficient of the present three plants on the Canadian side of the river at Niagara Falls, thus every cubic foot of water used in the Queenston power house will earn nearly twice as much revenue as if it were used at the falls.

The water of the Niagara river, after leaving the canal proper, enters a forebay which is practically a triangle-shaped enlargement of the canal, whence it enters the penstocks, or tubes, which lead it down the face of the cliff to the turbines in the power house which is located right on the edge of the river at the bottom of the gorge.

The turbines are technically described as of the vertical single-runner type; their capacity is 60,000 horsepower each, being greater than that of any others previously built.

Each electric generator is mounted directly above its own turbine, the revolving parts of each having a common shaft. The heaviest single integral part of one of these huge units weighs 300 tons. Air is employed for cooling these generators and the warm air issuing therefrom is used in winter to warm the building; the weight of air required every 2½ hours for cooling each generator is 690 tons, equalling the total weight of the generator itself.

Three-phase alternating electric current is generated at 12,000 volts, the frequency being 25 cycles per second; the current from each generator passes through its own switches and transformers the latter being used to step up the voltage from 12,000 volts to 110,000 volts; and the current is transmitted at 110,000 volts on the Commission's high-tension lines all over southwestern Ontario.

Six of the large new generators are now supplying the Niagara system, while of the remaining generators, two are under order for earliest possible delivery. The power canal provides for an ultimate plant capacity of over 600,000 horsepower.

The following table, based upon returns published in the last annual report of the municipalities, will convey some idea of what the charges are for light and power in some of the larger municipalities of Ontario:

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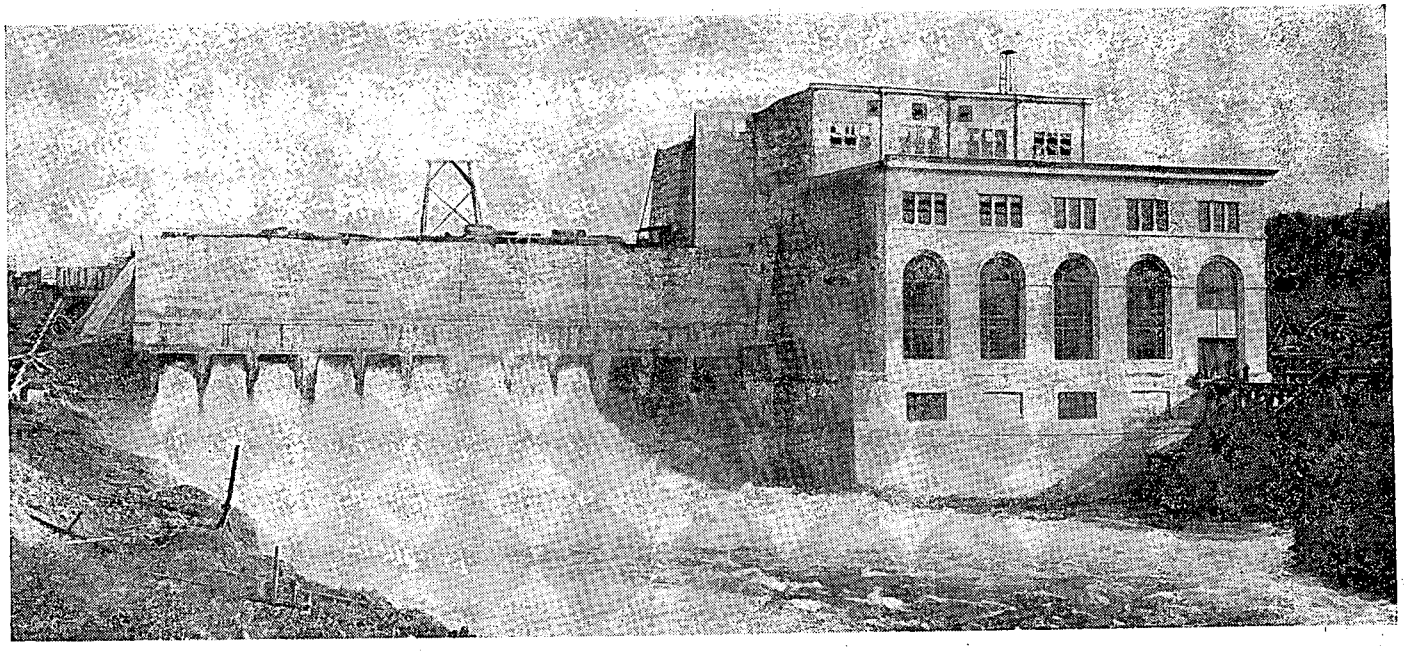


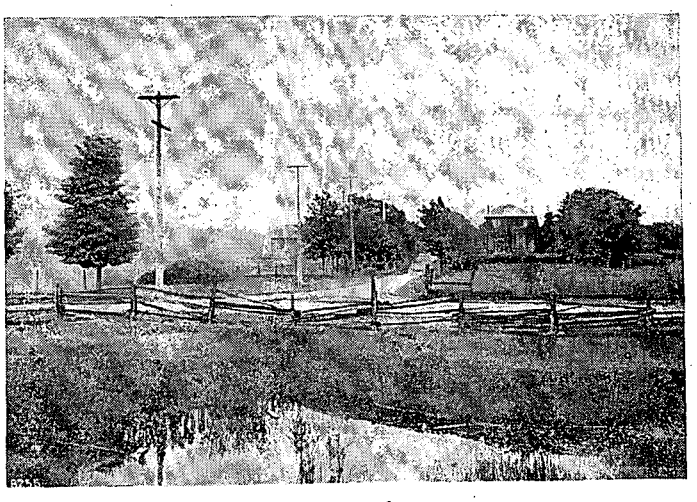
The Nipigon river development will supply 200,000 h.p. power for the citizens and industries of Port Arthur and Fort William and for the development of the resources of the Thunder Bay district, rich in pulpwood and minerals

Charges for Light and Power Service in Ontario Municipalities

Municipality	Population	Approx. Transmission Distance in Miles	Average Net Charge to Consumers Inclusive of All Charges		
			Residence	Commercial	Power
			Cents per Kilowatt-hour	Cents per Kilowatt-hour	Dollars per Horse-power per Year
Toronto	512,812	90	2.2	2.8	$21.00
Hamilton	114,766	50	2.1	1.2	13.63
Ottawa	110,708	1	1.6	1.8	13.52
London	59,281	132	1.9	1.7	25.14
Windsor	37,170	248	3.0	3.1	23.78
Brantford	32,786	85	1.8	1.4	19.56
Kitchener	23,027	102	2.4	1.8	16.60
Peterboro	21,790	2	2.9	1.8	15.97
St. Catherines	19,862	9	1.4	1.5	14.56
Guelph	17,922	77	2.7	2.4	14.41
Galt	13,092	93	1.8	2.0	14.45
Niagara Falls	14,805	1	1.6	1.5	13.26

THE success attained by the Power Commission in distributing hydro-electrical energy, not only to the larger cities and towns, but to villages and hamlets, stimulated the farming communities of rural Ontario to call for "Hydro" service. The problem of distributing power economically to farms is a very difficult one. The individual demands for power are quite small and irregular; also the distances to be traversed are relatively great. In 1921, a provincial Act—the Rural Hydro-Electric Distribution Act—was passed which recognized both these handicaps and also the desirability, in the general interest, of bringing the benefits of electricity to the farm. It provided a bonus on rural primary lines to the extent of 50 per cent of their cost. This policy has been generally approved; during 1922, approximately 440 miles of rural distributon lines were constructed to give service to over 2,600 consumers, and at present, the rural lines approved by the Commission aggregate over 1,000 miles and give service to about 14,000 consumers.

Although the aggregate load of the electrical energy thus distributed to rural dwellers is relatively quite small, its influence on the economic life of the Province is already a factor of great importance. The problem of keeping the younger generation on the farm and making farm life attractive is greatly helped and in some cases solved by the coming of electrical service.



A farm in the Hydro country

ALTHOUGH the province of Ontario has many water powers, distributed throughout its area, nevertheless, the extensive natural storage of the Great Lakes, resulting in the exceptionally uniform flow of the Niagara and St. Lawrence rivers, coupled with their concentrated falls and rapids, and the satisfactory basic engineering conditions for development, make these rivers unique for the furnishing of large quantities of hydro-electricity at low cost.

It should be recognized that along with the development and widespread distribution of electrical energy under cooperative municipal ownership, there has also taken place in various parts of the Province a great development of electrical energy for individual industrial purposes. The favor-

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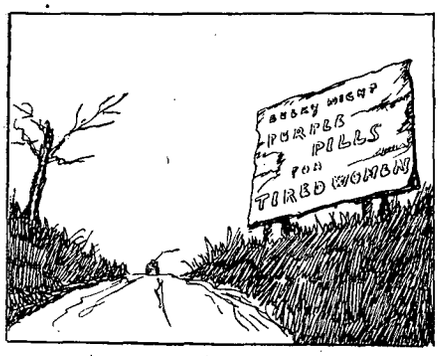
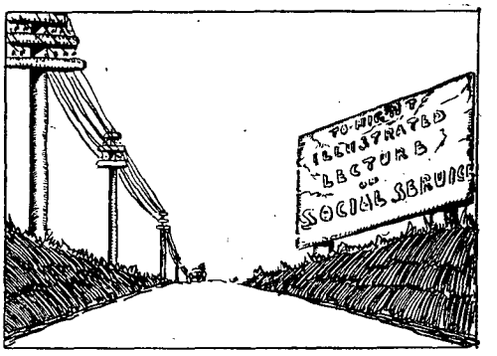


Before—

For these evils—the concentration of too many people in the cities, and the isolation, loneliness, and winter idleness on the farms—the Province of Ontario is trying the remedy of cheap power. How is it working?



and after

Following the Hydro

By MARTHA BENSLEY BRUÈRE

ENTERING the Province in the grey dawn, I saw through the car window a little mud-stopped log cabin, old, black, listing to one side, and blazing with light. The power line from Niagara, striding past on giant stilts had dropped a wire casually upon this remnant of a past age and dragged it into the 20th century.

The large cities—Toronto and London—have been made just as ruthlessly contemporary; I found their people using the electricity derived from Niagara Falls to operate their homes and their industries at rates which are only a fraction of what we pay. And as a result these cities were clean and prosperous—clean because there was very little soft coal burned and so almost no smoke in the air; but also because every electric device which cleans without dust is in common use. But if the large cities were made so desirable, why should folks stay out of them? Was the answer to this to be found in smaller places?

I went to the city of Woodstock, the perfect flower of the Hydro towns. This has a population of about ten thousand; the foreign inhabitants are six Poles, twelve Chinamen, ten Negroes, and twelve Italians—"if it ain't changed since they was counted last," my driver told me. The town line is hard to identify because the farms blend gradually into the large fields on the outskirts, the large fields edge up against the smaller yards, the little plots of ground crowd up to the short solid row along Main Street. The social life of the town shades out into that of the farms in the same way. I set out to call on four women of whom I knew. One after another, I found them out.

"I could have told you," said my driver. "It's what they call a 'pink tea' or maybe they're playing bridge. Every lady that ain't got a automobile of her own has had a taxi taking her out to Colbert's farm and they ain't coming back till supper time."

Later I saw the Colbert farmhouse. Mammoth silos towered above it with the barns set a little below, the smooth drive curved up to the door with autumn leaves blowing across it and an electric light at the gate to guide the coming and going guest. Obviously the farmer's wife who lived there was part of the social life of the town.

But on the day of her pink tea I wandered along Main Street and talked with such uninvited males as I could discover. There was the local newspaper office, very trim and ship-shape and very, very busy.

He was a brisk man—the editor. He owned a chain of three papers published in three neighboring towns and each community shared in the benefits of the combination news service. Between telephone calls and calls from his staff he told me about his town.

IT had no poverty—that is, none that lasted right along. Sometimes a family would be in hard luck for a while and have to be helped out, but they didn't need any charitable institutions. The neighbors looked after what had to be done. He didn't seem to remember much about crime. There wasn't any that you had to keep thinking about. Work? Oh yes—work for everybody all the time. Labor shortage? Maybe somebody might want more workers than they had but then there was usually some farmers' sons or daughters ready to come in for a while. Not many servants in the town. Most women did their own work. They had everything to do it with. But had I seen the factories in Woodstock? No? Well, after I had looked at them I would understand why there was work for everybody.

I told my driver to take me to every factory or manufacturing establishment in the town.

"There's what you would call two factory districts," he told me. "Oh, they're all run by Hydro; we don't have any other kind."

THIS is the catalogue of the industries of Woodstock in the order that I saw them: a braid and edging mill; a tannery; flour mill; a knit underwear mill; a lumber company which made sewing machine tops and dash boards for automobiles; a machine company; a printing press; a pipe organ company; a piano company—not doing much now because they supply the English trade and "they aren't

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buying much over there"; another underwear mill; a factory to make concrete mixers; a factory to make farm wagons and dump carts; a paper bag factory; a tapestry mill just taken over by an American firm; a combination lumber company and building contractors; a company making concrete pipes; a green house specializing in chrysanthemums, (this used a good deal of coal in addition to its hydro); another organ company; a lumber company making wheels and sleigh runners which, being steamed into shape, required coal in addition to electricity; an establishment which made brass curtain rods; a stove and furnace factory; a dairy and milk bottling plant; a manufactory of seed planters and lawn mowers; a maker of farm wagons and Buster Brown wagons for children; a chopping mill; another knitting mill; a hosiery mill; a candy and biscuit factory. Of these twenty-eight industrial plants, several have been built since the coming of Hydro and more than half have been improved and enlarged. The largest of these establishments of which I got the record employed about two hundred men and women, and the smallest ten. In this diversified collection there was work for men and women, for skilled and unskilled —work seasonal and work steady. It was an incredible number of industries for so small a place—why were they there? First there was no differential against them: power came to them at exactly the same rate as to the manufacturers of Toronto, an absolutely reliable supply—for Niagara runs 365 days a year. Second, they had an intelligent supply of labor which was far more dependable than in the cities, for over 80 per cent of the town's people owned their homes, and the house owner stays put. People did not have to go away in order to earn a living.

Neither did they have to go away to get an education, for in addition to the rather imposing high school, there was a small college.

And there was a good-sized hospital with a new wing building. They need not go away if they were ill. It was a well balanced town.

I sat in the office of the local druggist, breathing the clean smell of drugs in a perfect blaze of electric light and absorbed more information. He ran on this way:

Of course they leave the farms around here! They leave the farms everywhere if there isn't enough land to keep them busy. Suppose a farmer has enough land to farm himself or with one son to help him—and then he has four sons! About three of them have got to go away, haven't they? I'm a farmer's son myself; one of my brothers is on my father's farm. We knew of course that some of us would have to go, but it was a mistake always to put it up to us that we would have go to the city. They wouldn't do that now. Folks realize that you can live just as easy on a farm as anywhere else, and if there isn't room for you on your father's place, why, there's all Alberta and Saskatchawan. Plenty of young men from about here go out there for the harvesting—they get big wages and have a chance to see if they like the country. Some of them settle there, or maybe in the States. Of course it's not like our farming, they don't have Hydro.

Do we use Hydro? Of course we do! Our last bill? Average five to six dollars a month, and we have a stove and a grate and all our lights and a toaster and an iron and a sweeper and a hot water heater. But we'd have it if it cost twice as much. Why, the stove alone i worth three times the whole bill. Now last Sunday we put the dinner—there was a duck and things—well, we put it all in the stove before we went to church and didn't think of it again till we were ready to set it on the table. And the way it was cooked! You going to be here next Sunday? If you were I'd ask you down to have one like it. There's no way to roast duck that's up to the electric stove.

It was always like that. I think I could have eaten Hydro cooked food the rest of my natural life—people were so anxious to show me what their equipment would do. It was like showing off a precocious child and much safer.

LAST of all I went to the Hydro showroom where devices for use in the home were exhibited. An old couple who lived on a farm six miles outside the town were considering the relative merits of three electric cook stoves—attracted to one by a light that burned warningly till all the burners were shut off; to another by a griddle that got hot quickly; to a third by an oven which held the heat a long time. I left them still undecided and went to the office to see the chief representative of Hydro in the town.

He was at the moment a very busy man. A report was due from him that evening and he was finishing up his records. I gathered just a few facts. Here they are. In the town are 10,300 people. Two thousand homes are served by Hydro. If the families average five people each that means that practically everybody in the town is an electric customer. Four hundred and twenty-five of these two thousand homes use electric cook stoves. For one quarter of the town—it is divided into sections—the records were completed while I was there. This section includes 102 families who cook by electricity. Twenty-five per cent of these 102 have water heaters in their bath rooms, and all of them have light and most of the small appliances such as sweepers, toasters and electric flat irons. The average monthly consumption of these families was 448 kw. and their average monthly bills were $4.96. And a ton of coal to run a cook stove a month would cost in Woodstock about $15!

I went back to the show room. At first I thought that the same old couple were still studying the stoves, but a second glance showed me another pair of about the same age, and the same speckless respectability, with the same Ford patiently waiting outside.

IT seemed to me that in Woodstock the cure of cheap power was pretty effective. Ten thousand people were living together without crowding—living in houses of their own with bits of green around them and a chance for gardens if they chose. They were living in cleanliness and apparent decency. They were living in domestic ease through a plentiful supply of power at low enough rates so that they could use as much of it as they chose. They were living in the practical certainty of work enough for all of them all the time. The eight hour day prevailed and such wages as I was able to get the facts about were fair. For amusement there were two moving picture shows. There was also a social life as witnessed by the bridge party on the neighboring farm. If they left Woodstock for a great city it was not in search of work, or the conveniences of life, or social intercourse—but for some subtler, more personal, less definite reason—and as a matter of fact they tended to stay.

A town of 10,000 may not be a fair example. But I pursued the problem through a long series of little clean Hydro villages with anywhere from a thousand to three thousand inhabitants: Petrolia, which I approached through a sparse growth of oil well-derricks, where the slow electric pumps were chugging along competently with never a man in sight to supervise them; Watford, with its vine draped wire mill, the home of the fly swatter, though that is only

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one of its products, where the company stipulated for Hydro and a water system as a condition of keeping their plant in operation; Norwich, with its processions of farmers carting wagon loads of apples to the vinegar mill, and milk to the condensing plant, with the payments on its electric light bonds all provided for and $10,000 in the bank to be used in further betterments, or in a reduction of rates. These and many more like them with electric apparatus to make home life easy, and cheap power to make wage earning certain—towns which are neither growing nor dying but remain small farming and industrial centers.

Intermediate between the villages and the open country stand the hamlets, usually where two township roads cross, a store and a blacksmith shop, a church with a parsonage, the home of the doctor and two or three houses, sometimes the school—fifty residents at the outside.

"That," said the representative of the Hydro Commission, "is where I first went to tell them about Hydro—that blacksmith shop. Sat on the anvil which had plenty of time to grow cold while they asked me questions. There was one kerosene lamp and it smoked. Now look at it!"

The place was a blaze of light!

In another hamlet I found myself stopped abruptly in front of an old yellowing brick church. The Hydro representative told me—

When they got Hydro in here, they wanted to get it into the church the first thing, so on Saturday I had it connected up. Then on Sunday Sir Adam Beck spoke in the church, and Lady Beck gave the music. Well, what he said was as good a sermon as I ever heard. I don't remember if he used a text or not, but the thing he spoke about was "Let there be light." And there was the Hydro while he talked blazing all over the place.

IN another hamlet I found the wife of the physician entertaining four ladies at tea. We played conversational battledore and shuttlecock, between what they wanted to know about the states, and what I wanted to know about Hydro.

"Do you suppose that anybody here would give up Hydro?" I asked as I was leaving.

An old lady stopped her knitting and looked at me severely.

"There ain't *none!*" she declared.

From the hamlets it's a smooth slide into the farming district—the real Hydro country. We sped along on concrete roads, smooth, wide, following the long roll of the ground like bands of braid sewed on for trimming. Sometimes the poles carrying the wires followed us companionably along, sometimes the great steel towers marched off independently across the fields. If we were hunting some particularly intelligent farmer the answer to our inquiries was always:

"Follow the Hydro."

And we always found him by following it through.

The Hydro road led us periodically past little square buildings into which wires seemed to plunge and then emerge refreshed for further journeying—transformer stations where the current was "stepped down" for home use. They were about the size of anybody's dining room, and after I had peered into two or three and found them empty, I asked where the men were who ran them.

"Why nobody runs them! They run themselves! Once in a while they are inspected of course, but that's all."

Not much labor power is required to provide the farms of the Hydro country with light—a man to inspect occasionally as balanced against the need to fill hundreds of kerosene lamps and polish smoky chimneys.

I followed the Hydro far out in the country to the home of a dairy farmer. It was late afternoon and his wife in a fresh house dress with her greying hair piled high on her head had leisure to sit and rock and talk with me. The dinner was cooking itself in the electric stove, the electric washing machine was open and drying after the weekly wash.

"Nothing to do by hand but the wrist and collar bands," she told me. "Annie!" she called to her sixteen-year-old daughter. "You better iron out a couple of the boys' shirts. They'll want 'em if we go to the movie after supper."

So Annie placed the ironing board in the doorway where she could talk as she worked, connected the electric iron, and went serenely to work. A back breaking farm washing done and the family gay and ready for a six mile drive to town in the evening! Two little girls ran in from school, and then there were noises from the barn. The cows were coming up. My hostess went to speak to her husband and soon there were sounds of a farmer getting himself cleaned for company. Presently he came in an asked if I wouldn't like to see the milking. They were using three electric machines that night. It is the safest way I've ever seen to milk a cow! In the barn I met two nice sons of going-to-the-city age—but not gone, and with no present intention of going. One of them told me,

You can milk a good cow almost as quick by hand as you can with a machine if you're a good milker, but you can only milk one at a time! With these, either one of us can do the whole twenty-three about as quick as we could do three by hand—and no hard work about it either!

BACK in the house, I asked if my hostess had an electric sewing machine, and she said "No," she didn't use the machine enough to bother with a motor. It was so cheap to get clothes ready made and they looked better. She didn't like sewing anyway and the mending was as much as she cared to do.

"What are you and your neighbors going to do with the free time Hydro gives you?" I asked her.

She fixed me with a stern, and antagonistic eye. Obviously I had been tactless.

"Something we like better than house work, I should hope. What do *you* do?"

And that's what I found all through the Hydro country—farmers' wives doing something they like better than house work. In one case a flower garden lovely even in October; in another case singing lessons; again it was visiting about or joining a women's club in the village; sometimes it was just time to rest.

AND again I followed the Hydro to the home of a Man who kept Bees. There is a story goes with that man. He had a large rolling farm on which he planted more than his share of apple orchards, and plenty of red clover, and then began on bees. He is one of those rare people whom bees like. He can take them in his bare hands, dip masses of them up like water when they are swarming and they do not sting him—instead they fill his hives with honey and his purse with gold. And his swarms increased so that the blossoms in his orchards and his clover fields were not enough to feed them and he boarded them out with his neighbors. Now, hives set in the orchard mean plenty of bees while the

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trees are in bloom so that the pollen will be carried to every flower and the trees hang thick with fruit. So the bee man's bees were welcome boarders, and when he gathered the hives up in the autumn they were invited to come again. He laid aside money so that he could leave the farm to his son, and go to town where the mechanics of living would not press so heavily on his aging wife.

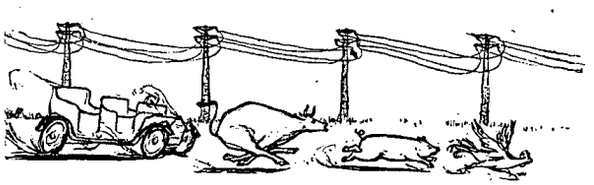
And then one day the representative of the Hydro Commission came down his road and tried to persuade him to sign the twenty year contract which would bring the lines to his house, telling him how much easier the house work would be, and how they could have running water in the house, pumped by Hydro, and light, and an electric stove, and all the things he had expected to get if he moved to town. The Bee Man asked for two days to consider and when the Hydro representative came back he signed the contract.

You see, we were just about ready to do something very important—we were going to town to live. And I got to thinking about how I was going to miss my old dog that I'd raised from a pup, and how I'd have to come miles if I wanted to pull an apple off that tree by the gate, and the lilacs we'd planted over by the fence, and all the things that had happened in the forty years we'd been married and living in this place, and so we've decided that we'll just take Hydro and retire right here on the farm.

And now he and his wife are still in their own home—"retired." And his son for whom he has built a house across the road, is running the farm. They have a cold storage place for their ever-increasing crop of apples, and proper winter quarters for their profitable bees, and the old man and his old wife potter about happily with their old dog and pull the apples from their favorite tree and smell their lilac hedge, and live in a sunset of contentment.

IT seemed appropriate to leave the home of the Man who Kept Bees and follow the Hydro along the smooth roads till its steel towers stood out black against the sunset and the whole of Ontario was a field of fire fenced in by a ring of electricity, and not a factory chimney in any of the distant towns to smudge the sky with black, and all the whirling windmills that had once set like great daisies against the sky, broken and wilted and useless, and all the mud roads turned to concrete, and all the pioneer poverty done away.

The red sunset turned to black rain and we began to make haste slowly for we were in a dairy country—little herds of cattle were crossing the road, and when has a cow been willing to make way for a car? They sloshed across the bright line of our headlights toward the twinkling lights from the barn doors, the rain streaming from their sides. Further on when they were all housed the rows of barn windows blazed out brilliantly like factory lights in a town, for it was milking time. And then we began to see the kitchen lights flash up, and when the milking was done and the long rows of barn windows dark again, lights came into the dining rooms, and an hour later we would see through the rain that it was the sitting room lights that were on, so that supper was over and the dishes done and the family settled to enjoy a longer evening than had existed for them before Hydro had shortened the work day. The rain blew in straight flat sheets and the gate lights that some of the farmers had left burning shone at us like very wet stars. Then the lower floors went dark and the upstairs lights shone through the curtains, and there were all the farm families taking their hot baths, and reading their last minute stories, and finally pulling the coverlets over their shoulders and switching off the lights in the certainty that the breakfast oatmeal was hot in the insulated oven, that there would be hot water in the morning and no cook stove to start and no pre-daylight stoking to do but the furnace, and that's no more than a city dweller may have on his mind. And then the farm houses began to go black and we drove on in darkness for the Hydro Country had put itself to bed.



THE success of the Ontario experiment is due to a combination of factors, I do not know which should be called first or last.

The farms in the Hydro Country are generally small. Two hundred acres is considered too much and somewhere between one hundred and one hundred and fifty about right. Under the Ontario conditions, a strong intelligent farmer can work one hundred acres reasonably well by himself. As his sons grow old enough to help him he can cultivate about fifty more. A birth rate great enough to produce more than one son per family creates in a region of small farms a human surplus that must be drawn off. While farm life was as hard and lonesome as it was before good roads and automobiles and telephones and Hydro came in, not only all the surplus sons but the one who would naturally succeed his father tended to go to the towns where life is easier and the social needs of a gregarious animal are better met. But with Hydro life on the farm is not so hard. Young men and women who have grown up in the midst of electric equipment are not so reluctant to go to new farm lands where such mitigators of toil are in prospect, nor at all adverse to staying on the paternal acres where they already exist. The farmer's son in the Hydro Country knows the nearest village pretty well. It has—in the Hydro Country, some sort of industry, usually more than one, where he may have already worked between seasons. This is the first stopping place for the farmer's son who is not going to be a farmer. Sometimes he stays there. But more often he goes on to a place, with from ten to twenty thousand inhabitants, and a variety of industries in one of which he finds work; settles down, marries and establishes a home. These small industrial centers are becoming an effective dam to keep the flood of population out of the great cities—in the Hydro Country.

AND then all through the Hydro Country I saw what I saw at the home of the Man Who Kept Bees—a house built by the father for the son who stays at home. And this means that plenty of farmers are retiring on the farm, and plenty of sons are taking over the cultivation of the land, so that the basic need—that the soil shall be tilled—is being met.

I came back toward the everlasting, swirling, rushing, source of Hydro—past the tiny log cabin with the electric lights—and across the suspension bridge high above the tumbling green water which has succeeded in turning industry back upon the land, has checked the human tide toward the great cities, and created a land with no visible signs of poverty.

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The vice president of the West Penn Power Company and his labor foreman checking up at a super sub-station; in a way, they stand for capital and labor against a background of lightning arrestors and oil switches

Cast of Characters

in the New Drama of the Power Makers

WORK PORTRAITS BY LEWIS W. HINE

IF the United States were to throw open vast territories for settlement, as in the days of the Oregon trail, the covered wagons would be driven by men of the frontier type. If gold were to be found in a remote range of hills, prospectors would flock there. Automatically opportunity would sift out from settled populations and settled industry men of the venturesome type.

Somewhat the same thing has happened with the throwing open of the new industry of power making, reaching as it does from the sources of energy back in the hills to the centers of human congestion and congregate manufacture. The visitor to a power plant is struck by the youthfulness of the men, their resourcefulness, their humor. He is struck by their sense of responsibility and power, which goes not so much with muscular strength as with control over a force greater than their own. They are men with clear-seeing eyes and slow hands. They are neighbors to a danger swifter than a cat. They are explorers and builders. The power makers have been chosen by a process of natural selection as deft and certain as that which chose the pioneers and the gold seekers.

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ASSISTANT MASTER MECHANIC

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FURNACE REPAIR FOREMAN

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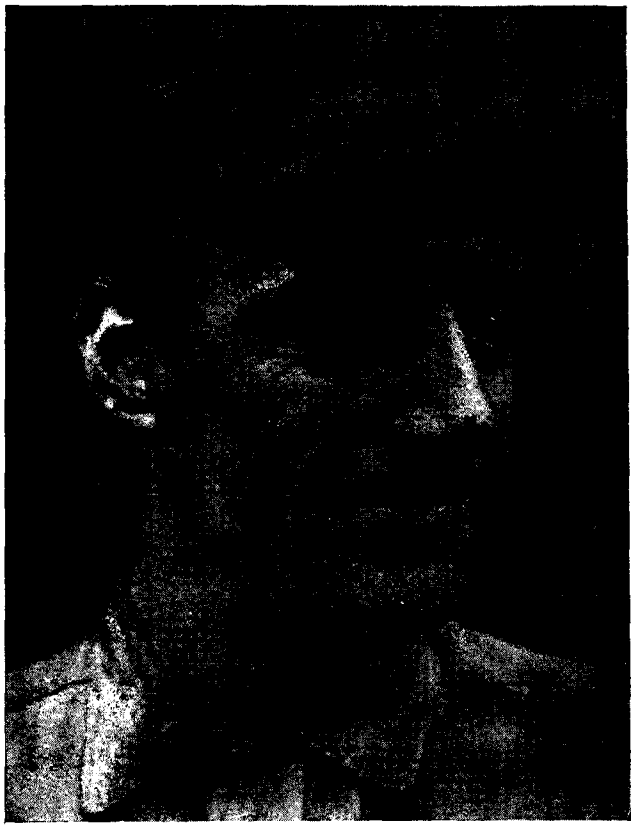
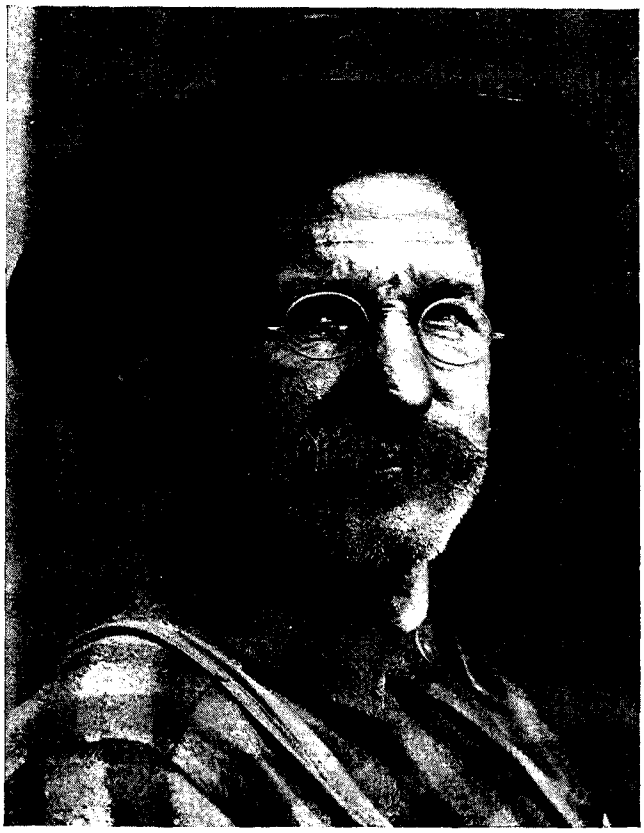


MEMBERS OF THE WORKING FORCE

Above — a couple of electricians, below — a labor foreman and a "super-shoveler," as the man who runs a modern stoker might be called



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MEN IN THE MANAGEMENT END

The president of a power company, his superintendent, the chief engineer of a power house, and a construction engineer

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Photograph by the Fairchild Aerial Camera Co.

COAL MINE AND POWER PLANT

Aeroplane view of the Colfax Plant of the Duquesne Light Company, eighteen miles above Pittsburgh on the Allegheny River. The mining village of Harwick can be seen at the top (left center) of the picture. Thence the coal is brought direct from the mine by railroad to the great storage space, back of the plant, which accommodates 200,000 tons. The Colfax Plant is capable of generating 120,000 kilowatts or 160,000 horsepower. A new unit is under construction at the right.

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The Long Look Ahead

By MORRIS LLEWELLYN COOKE

Director, Pennsylvania's Giant Power Survey

A SIMPLE logic lies back of Pennsylvania's intense interest in power: it uses more than any other state in the Union. In the steel industry alone, within a radius of thirty miles of Pittsburgh, a volume of power is used which is the equivalent of two-thirds of all the power used in the entire district between Washington and Boston, and running back as far as the line of Harrisburg, Pennsylvania. Of coal, our chief reliance for power, Pennsylvania produced last year over 40 per cent of the national output. Our major railroad systems are pivotal in national transportation; and with them the power problem is ever uppermost—never more so than as they approach complete electrification. For this reason Governor Pinchot with the hearty cooperation of the legislature established a Giant Power Survey Board to inventory the state's energy resources and make recommendations for their utilization.

Under the system of private ownership common in Pennsylvania, such inquiries in the past have naturally been confined largely to a study of steps designed, primarily, to advance private interests. The present inquiry, on the contrary, will be based on a study of social needs: we seek to find out how power can be made to contribute to the fulness of life. We believe that electrical technology has advanced to a point where the use of current can be made so inexpensive as to revitalize the whole social fabric. The willingness of the private agencies occupying the field to meet proper social requirements will be assumed.

One of the most frequent criticisms of our age is that we do not use the technical and other information at our disposal. This is true even in the electrical field. Giant Power then is an effort to take advantage of certain broad propositions affecting the generation and use of electricity which are as A B C to Edison—and were to Steinmetz—and yet which have not gained recognition in the every day world of human affairs.

It would seem that no power system for Pennsylvania can satisfy reasonable expectations except as provision is made for large sized stations—say not smaller than 500,000 kw., located at or near the mines, supplying current to a trunk system of transmission lines reaching 220,000 volts with large capacity to carry power long distances, and providing for the recovery of the by-products of coal that are now generally wasted in smoke. According to Sir John Cadman, president of the British Institution of Mining Engineers,

> A very few years may see it a penal offense to burn raw coal in any of our towns. * * * While the popular view of coal is that it is something to be burned, the scientific view is tending to be precisely the opposite. It is that coal is too valuable to be burned, that to burn it is to squander it, that the by-products of coal (ammonia sulphate, benzol, creosote, tar, gas and crude light oils) are of greater moment than the coal itself and that not until these by-products have been extracted, should the residuums (i. e. the heat producing constituents) be used.

IN operating an electric plant "par"—to use a golf term—means working the equipment to full capacity through the entire twenty-four hours and every day in the year. This, of course, is an impossible achievement, for in order to insure continuity of service every station carries extra equipment, known as "standby," as an insurance against accidents. Again, every station has its periods—both daily and seasonal—of greatest demand and at all other times facilities absolutely required by these "peaks" may stand idle or be used at less than full capacity. In order to fill in the valleys between the peak demands for current, every station cultivates a diversified use for its product. It is found that the larger the number of customers and the more broadly these are distributed as to character and use, the steadier will be the demand. The measure of this character of demand is known as the "diversity factor." It is only one of the considerations affecting the "load factor" of a station or a system. By load factor is meant the actual accomplishment during a day or a month or a year in relation to the theoretical "par" for the same period, calculated from the maximum demand during that period. These annual load factors vary in large representative plants from about 40 per cent to 64 per cent. Therefore an integrated transmission and distribution system, pooling every kind of demand for current, and at all times, is requisite if we are to accomplish such obvious economies as attend filling in the valleys and flatting off the peaks.

The public should be on notice that the most economical electric service implies complete integration for any given "pool of power" or district which because of technical considerations, such as the economical transmission distance, should be treated as an operating unit. Within such an area anyone having energy to dispose of will pour it into the pool; anyone requiring power will withdraw it. To make this feasible, a centralized control involving at least half a dozen states is necessary in the northeastern section of the United States. This means such complete interlocking of all electrical facilities as to constitute monopoly,

The Vista of Cheap Power

THE Giant Power Survey of Pennsylvania breaks the binding cords of technical precedent: it seeks to find how power can be made to "contribute to the fulness of life." It reckons with human as well as engineering factors which were comprehended in such earlier concepts as "superpower." Giant Power would link the energy of mines with that of waterfalls, recover valuable by-products in bituminous coal, supply current to the trunk lines of an integrated transmission and distribution system; spread electric energy to the farm and reduce rates to the small consumer in ways that will "revitalize the whole social fabric."

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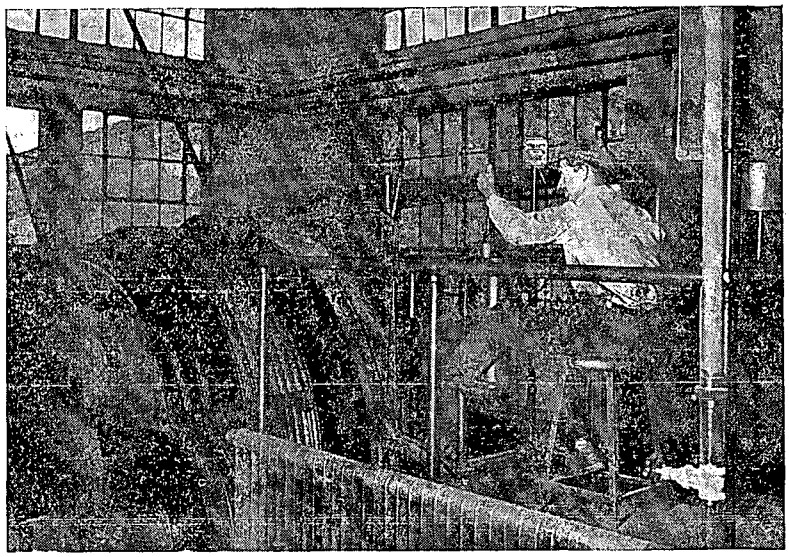
and monopoly on a wide scale in energy, perhaps the most important factor in our material life. Whether as a public or as a regulated private enterprise, it still spells monopoly.

The consolidation and expansion of electric companies and systems is now going forward at a rapid rate. Theoretically, this process is under both the supervision and control of our public service commissions; but the day to day grind of rate cases and other relatively minor matters almost preclude any vital participation by these commissions in planning out the new electrical day.

So that the establishment of large sized by-product and power stations, located near the coal mines, supplying current to the trunk lines of an integrated transmission and distribution system which also carries the electricity derived from water power; the while making possible the distribution of current to the rural population; together with a reduction of rates, especially to the small consumer,—these are the immediate and definite objectives of Giant Power.



Photograph by Lewis W. Hine

The man at the hoisting machine is the connecting link between the mine and the power house at the mine mouth

THIS program is one which is capable of fairly full development within the state lines of Pennsylvania, which can provide for herself unlimited electrical power at a cost probably as low as anywhere else in the United States, and is not therefore dependent on any form of interstate cooperation. But in the interest of national well-being, and because of technical considerations, the present state administration is convinced that electrical development should not know state lines, and believes that there is ample room for interstate cooperation especially between New York and Pennsylvania and each of the neighboring states.

Imagine building trunk line highways in either New York or Pennsylvania without regard to the highways system of the other State! The arguments for planning on an interstate scale are much greater in the case of an electrical trunk transmission line—a main highway for energy as contrasted with a main highway for vehicular traffic. And yet consider the absurdity of having a road of the character of the Lincoln Highway on the Pennsylvania side spill its traffic into a township dirt road on the New York side. The same arguments for a unified system are to be found at the border in both cases. But in planning for the transmission of electric energy, provision must also be made for those adjustments in operation made necessary by accidents at far away points. It may happen, for instance, that a temporary power shortage or an interruption in the service in central New York may be met by a diversion of current from southwestern Pennsylvania. With our principal power supplies located on the Niagara, St. Lawrence, Delaware and Susquehanna Rivers, in the Adirondacks and in the coal fields of Pennsylvania and West Virginia, state lines have about as much relevancy as ward lines have in planning a metropolitan water supply.

Estimates of the electrical demand by industry, by the railways, and for commercial, urban and semi-urban residence use are made with comparative ease, even for some years ahead, on the basis of known present rates. It is more difficult however to estimate the increased consumption which will undoubtedly follow rate reductions inherent in any Giant Power program.

THE rural demand however is in an entirely different class. We cannot name with any certainty the percentage of farmers to whom current at present rates will be attractive, nor what difference lower rates would make. Approximately 50 per cent of the population of Pennsylvania, or 3,500,000 people, are now without access to electrical service; the percentage of the whole area of the state not reached by distribution lines is much greater. One of the objects of the Giant Power Survey will be to determine the approximate cost of reaching a very large percentage of our rural population and then to make suggestions as to the financing which will be required to carry electricity to the farms.

Within the electrical industry there is a growing interest in this rural load. While in size it does not compare with the industrial, it is broadly speaking an "off peak" load and is not as subject to seasonal fluctuations or to the variations due to the business cycle as is the industrial load. But the industrial load because of its relatively large volume is, and probably always will be, the great consideration in laying out transmission lines and therefore the Giant Power Survey is making an effort to determine probable industrial demand ten, twenty and thirty years hence.

THE super-power idea, as contrasted with Giant Power, came into vogue during the Great War. Because of the discrepancies between the demand for power and the supply at various manufacturing centers, the government adopted the policy of forcing inter-company connections where this would permit the transmission of current from areas of excess to areas of shortage. Each company held exclusive rights in a given territory and with very few exceptions, avoided any connection with companies operating in adjacent territory. However, developments in the art of long distance transmission and a growing recognition of the economies resulting from any widening in the territory served, prepared the companies for an era of inter-company cooperation. Such inter-company cooperation is taking place between the Duquesne Light Company in the City of Pitts-

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burgh and the West Penn Power Company, occupying a wide territory surrounding that city, which have agreed to buy and sell from each other current which is exchanged at 17 points of contact between their two systems. Within the last few months, tie lines have been laid under the Delaware River connecting the Philadelphia Electric Company operating in and around the city of Philadelphia and the Public Service Corporation of New Jersey, operating in all parts of the state of New Jersey.

Interconnections between separate companies on the West Coast give a continuous line for twelve hundred miles from Portland, Oregon, to San Diego, California. Interconnections between the companies operating in the Carolinas, Georgia and Alabama made it possible during a recent drought in North Carolina to supply the shortage with current from the Sheffield steam plant at Muscle Shoals, Alabama, some 800 miles by transmission line. The same type of developments is going on in New England and in other parts of the country.

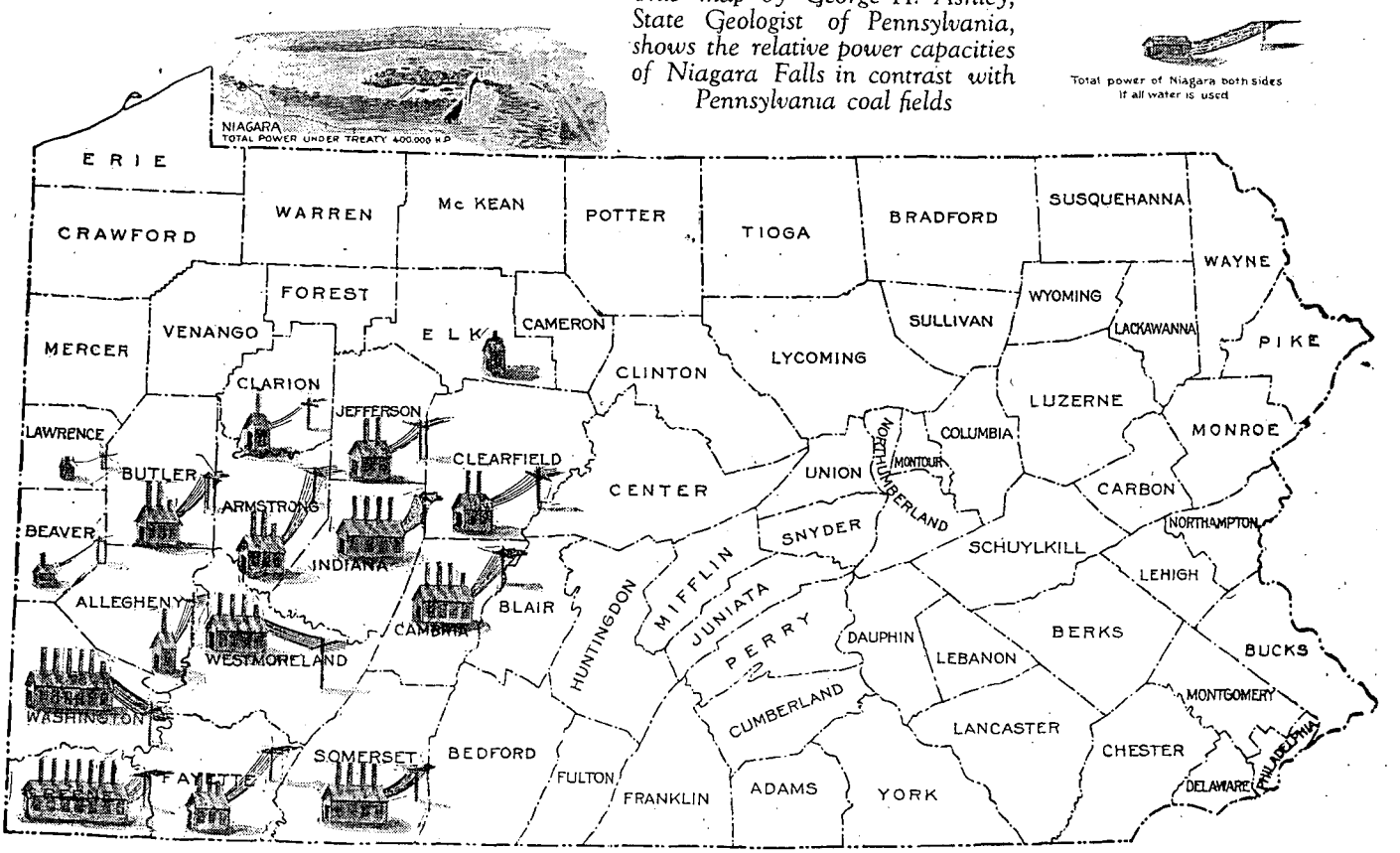
With the rapid increase in the demand for current and the lowering of station costs through the use of larger generating units we see companies, which heretofore manufactured current at a number of small stations, seeking to build up one large scale plant and either dismantling the former stations or maintaining them for emergency service only. The district where I have my country home was formerly supplied by current from a station equipped with 260 horse power reciprocating engines and located 8 miles away at Doylestown, Pennsylvania. Several years ago we were transferred to a somewhat larger station at Yardley, Pennsylvania, equipped with 1,200 hp. reciprocating engines. Through the purchase of the Bucks County Electric Co. by the Philadelphia Suburban Gas & Electric Co., about July 1, 1923, we get our current from the Crombie Station near Phoenixville, Pennsylvania, some 35 miles away where there are two 5,000 kw. and two 10,000 kw. General Electric steam turbines. The day cannot be far distant when this source of supply will make way for 50,000 kw. units—perhaps much larger—located nearer the coal supply at least 125 miles away.

What is the distinction between Giant power and superpower?

The super-power conception—both as to its strength and its inadequacy—found expression in the superpower survey conducted for the Department of the Interior by William S. Murray, a consulting engineer. Essentially this superpower idea consisted almost entirely of a tying-in of existing facilities and the gradual elimination of the units operated at relatively high cost. By-product recovery was only casually mentioned. Some of the largest stations were to be located on tide water, thus requiring the indefinite continuance of the uneconomic transportation of coal long distances from the mines. There is scant mention made in the superpower report of the interest which the small user—especially the farmer—has in lower rates and wider distribution.

Mr. Murray says that superpower is a system that "would furnish power to the railroads and the industries within the territory between Boston and Washington" and "would and should fail to achieve its purpose if it should seek to supplant or even to compete with existing electric

This map by George H. Ashley, State Geologist of Pennsylvania, shows the relative power capacities of Niagara Falls in contrast with Pennsylvania coal fields



Each chimney on the power houses in the coal producing counties of Pennsylvania, shown on this map, represents coal enough in the county to produce a million horsepower for five hundred years. Each wire represents 400,000 hp., the equivalent of the power derived from Niagara from the American side under the present treaty.

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utilities. . . . The market for superpower energy will be furnished by the electric utilities, the industries and the railroads." Super-power "comprehends a plan of power production that includes the generation of electricity by steam at tide water and on inland waters where a sufficient quantity of condensing water can be obtained." Super-power "will be a regional system supplying power . . . to the two agencies that are most vital to American existence—industry and transportation."

Mr. Murray's conception was undoubtedly useful in educating the industry to the logic of interconnections but otherwise it left the field of power integration practically untouched. It should be recalled that even fairly widespread interconnections do not necessarily give access to the cheapest power or spell low rates to the consumer. In fact even high voltage interconnections between companies may accomplish relatively little in the absence of a high capacity trunk transmission system connecting up a large number of customers and a big demand over great distances with the lowest cost sources of power.

GIANT Power, like the superpower idea, also had its inception during the Great War. Robert W. Wooley, then a member of the Interstate Commerce Commission, in a series of forceful and far-visioned memoranda, addressed to President Wilson and other government officials, called attention to the great economies which might result from a unification of the railroad and power fuel supply with the almost feverish by-product activity occasioned by the demand for the chemical toluol—one of the constituents of gun powder, and a coal by-product.

Under the inspiration of Bernard M. Baruch and the active leadership of Eugene Meyer, Jr., an Emergency Power Bill was drafted, and had the war continued, this bill would have passed and several of the suggestions now embraced in Governor Pinchot's conception, such as sending current from the mines to cities on the Atlantic seaboard, and by-product recovery, would have been incorporated into the unified power system contemplated by the Act.

Giant Power does not acquiesce in, and in fact actively protests against, the tremendous wastes due to a failure to recover the valuable by-products contained in all bituminous coal. It has been estimated that there are used simply for power purposes in Pennsylvania alone between forty and fifty million tons a year of bituminous coal divided about as follows:

(a) at bituminous mines	3,500,000	tons
(b) for electric public utilities	4,000,000	"
(c) by industries (including direct application of heat or process steam) between 17,000,000 and 24,000,000 tons, say	20,000,000	"
(d) for locomotive fuel between 14,000,000 and 21,000,000 tons, say	17,000,000	"

So far as we have been able to discover not one pound of this is processed for the recovery of by-products.

But it is frequently said that there is no market for these same by-products even if they were to be recovered. This was formerly the line of argument used to defend the wasteful bee-hive coke oven. But, during the last five years especially, that wasteful mechanism has been so rapidly replaced that in 1922 almost 80 per cent of all the metallurgical coke manufactured in the U. S. was by-product coke. In fact there was an increase during 1922 of nearly nine million tons of by-product coke or 25 per cent. The fact that the market was able to absorb this tremendous increase in the resulting by-products would at least suggest that the point of saturation has not been reached.

There are many different ways of processing bituminous coal when carried on as an adjunct to a power plant. The general purpose of them all is to burn only those elements which have a heating value and to recover the residue. Sometimes the largest financial return will be secured by burning the by-product gas under the boilers of the power plant. Where there is a city market for the gas, the coke could best be burned under the boilers. Sometimes the process of distillation is carried on in such a way as to furnish such large quantities of a lean gas known as producer gas that there are no by-products except the resulting ash. Research and invention are today very active in this field.

CONSUMER'S rates for electric current—especially for small users—are of the essence of any discussion of Giant Power and its possibilities. Every reduction in rates generally speaking brings about an increased use of current both directly and indirectly through its application to new uses both in the factory and the home.

In the early days of the industry people thought of electricity largely in terms of the incandescent lamp. Thus the trade association of the electrical industry still goes by the name of the "National Electric Light Association." Residence lighting in those early days afforded practically the only outlet for current. Rates were high—as much as 30 cents per kilowatt-hour—and incandescent bulbs sold for as much as $1.50 apiece. But when the electrical industry realized that current usable for light and heat, and especially for power, was really the product of these "lighting stations," there began a campaign for the elimination of the isolated lighting plant so named to distinguish it from a central station doing a regulated business in power for the benefit of a number of customers. The process was artificially expedited by rates discriminating in favor of power service, so that current was sold on narrow margins and even at a loss, to industrial users formerly operating their own power plants.

Largely because of this historical development, present rate schedules bear heavily on the small user—especially on the householder—as contrasted with the large industrial user. The spread appears to be too great between the classic rates now charged for domestic use—15 cents per kilowatt-hour in rural districts and 10 cents in most urban districts except the largest—and the rates charged the largest industrial users—one cent and sometimes below that figure. These typical American spreads between high and low prices, frequently 20 to 1, are very much greater than those encountered in other countries. No such range in price is encountered in the rate schedules of our relatively few publicly-owned electrical enterprizes such as those of Cleveland, Ohio, Los Angeles, California, and Seattle, Washington. Rate increases, quite general since 1914, have been applied almost exclusively to current used for industrial and commercial purposes and therefore have tended to reduce this discrimination. Because of the unnecessarily high rates for home use we have not begun to see that widespread electrical development in the domestic field which will follow when rates are freed from this type of discrimination.

(*Continued on page* 651)

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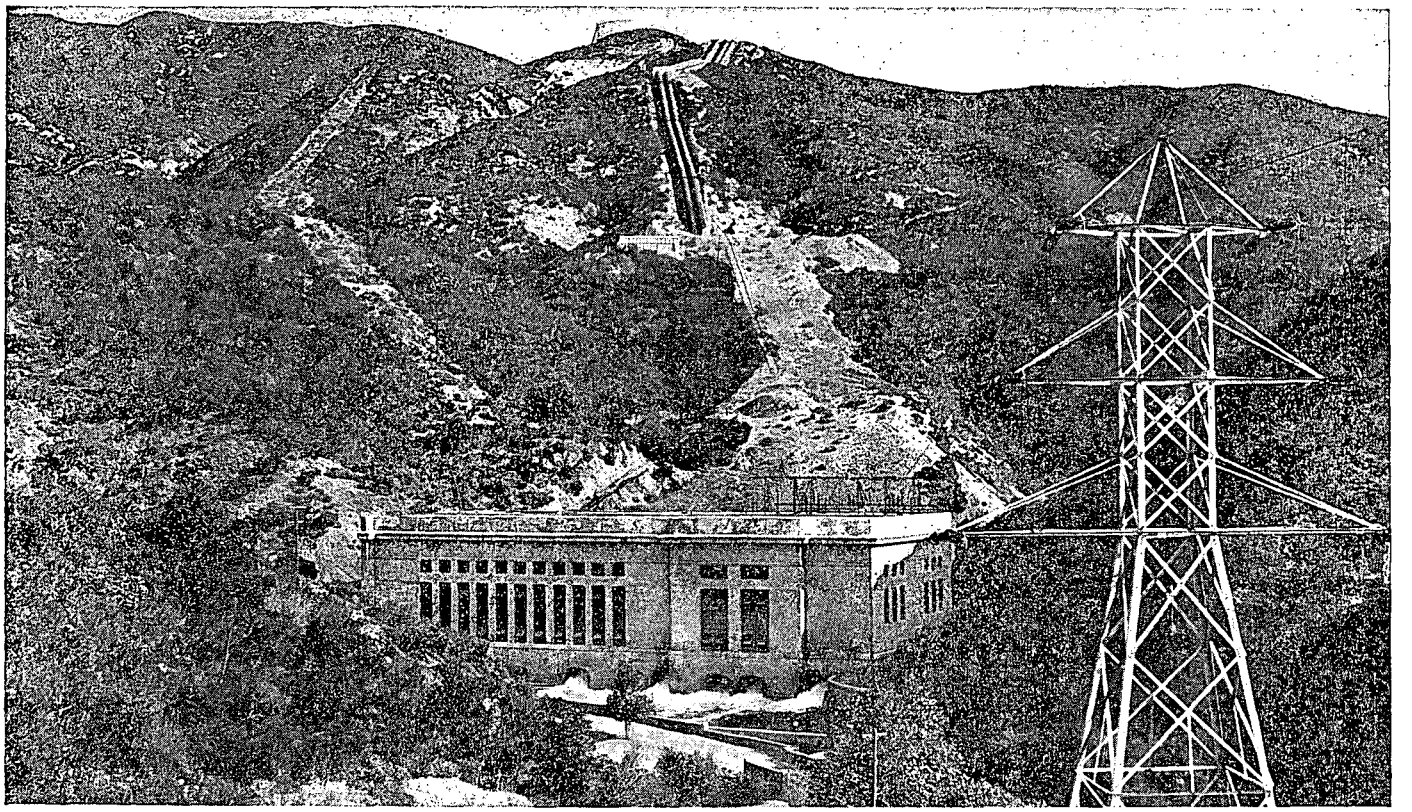

Photographs from the Pacific Gas and Electric Company

San Francisquito Power Plant No. 1 generates power available for Los Angeles, fifty-two miles away, and forms part of an inter-connected system covering a distance of 1,200 miles on the Pacific coast, principally derived from water power

Pools of Power

By H. G. BUTLER

THE smokestack which denotes industry in the East becomes the electric power line in the West. If the industry of the Pacific Coast still depended on coal it would produce very little for the rest of the world, and its own needs for what others produced would be small because its population would be inconsequential.

The nearest coal supply to the coast is Utah, over 750 miles away, with Australia as the next best source. So when it was discovered that by using 11,000 volts, electricity could be successfully transmitted sixty miles and more, the seemingly boundless power in the mountain streams was welcomed as an offset to nature's niggardliness in the matter of coal. As the voltages were increased, it became possible to transmit power to still greater distances, and before cheap oil was available for fuel the Coast states had settled down to electricity. Today California oil is largely pumped from the ground by electric motors, and if coal deposits should be discovered on the Coast they would be worked by electrical machinery.

But the growth of the power industry has been by no means spontaneous. A steam electric plant can be installed to meet the demand that exists, and as that grows, a unit or two can be added. With the hydro-electric plant in the mountains the basic expenditures for dams, canals and transmission lines are so great, and the time required for construction is so long, that the demand must be foreseen a long time in advance, and the installation made for a greater capacity than the existing market warrants. As result, each hydro-electric plant as it was completed had surplus energy, to sell which transmission lines were built to markets farther and farther away; and when a line was built between a mountain source and an industrial center the intermediate territory, too lean to support a power development alone, became in itself a market for the surplus. Now power lines criss-cross the state and the demand for power is increasing at the rate of 10 per cent annually.

This was not done with-

California and the Coast

CALIFORNIA is the Cinderella among our American industrial commonwealths. Without the coal of her rich sisters, her mountain streams have proved to be the silver slipper of a new energy. Today the superpower zone of the Pacific Coast generates one-tenth the total electric energy annually consumed in the United States. Here we find forecasts both of the social consequences and the public issues which will characterize power developments elsewhere in the next ten years—the ever-extending power lines, household and farm use on an unprecedented scale, the problems of consolidation, of regulation covering financial and construction programs, the clash between public and private developments, regional, state and municipal.

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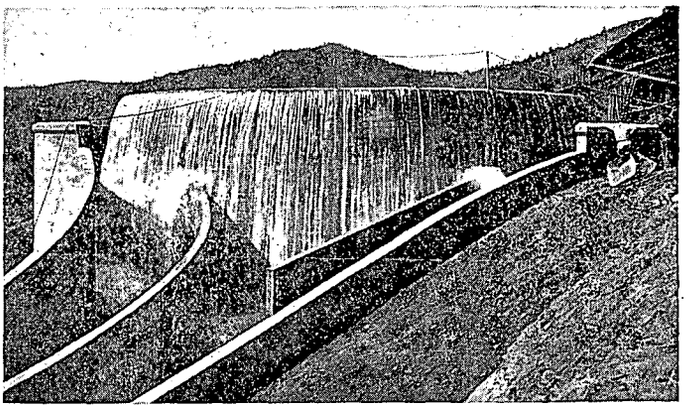
out salesmanship. From the first the power companies sold not only electricity as a product, but electricity as an idea. A few years ago it became apparent that the four branches of the electrical industry—the central station generating and delivering power to the consumer, the manufacturer of electrical appliances, the jobber who handled those appliances, and the contractor-dealer who sold and installed them—would have to work together in order to extend a market already saturated to an unprecedented extent. Together they organized the California Electrical Cooperative Campaign, hired a field force and began work with the man who comes most in contact with the public, the contractor-dealer. From the dealer they worked back through the jobber to the central station.



Surge chamber spilling over

Architects, builders and real estate dealers were brought together to further the campaign. Talks were made before women's clubs, and every other organization that would listen to its representatives; electrical homes were built throughout the state, which have been visited by over 325,000 people, with the result that a six room bungalow which would formerly have been built with one or two base plugs, today has more than two "convenience outlets"—a California name for base plug—in every room. At the present time two Pullman cars are being fitted up; one to demonstrate "electricity in the home" to the smaller communities, and the other to take "electricity on the farm" to the farmers throughout the state.

The result has been, a highly concentrated and diversified business:

ELECTRIC POWER

Description	U. S.	Cal.	New Eng. States
Approximately per capita consumption of kw. hours per year	400	1200	
Percentage dwellings wired	35	83	
Average rate for electricity	$2.17	$1.42	$2.82

THE USE OF CALIFORNIA POWER

Manufacturing	41	per cent
Railways	21	" "
Agriculture	16	" "
Lighting and domestic purposes	16	" "
Mining	6	" "

There is probably nowhere in the world an agricultural territory so well served by electricity as the two great central valleys of the state, the San Joaquin and Sacramento valleys. Transmission lines traverse them from end to end and cut them crosswise, and where transmission lines do not extend, the distribution lines do. Except on the edge of the valleys, along the foothills, the farms are all reached by electric wires. In some of the more densely populated sections the distribution lines are along every road, with service to every house.

The main use of electricity on the California farm is for the irrigation pump. But there are no labor saving electrical appliances which are not also found on the farm, and the farmer's wife is probably in advance of her sister in the city in securing the numerous devices for the house to make the home more liveable and lighten the house wife's work.

It is no unusual thing to see a new farm cottage completely equipped with electrical appliances—lights, vacuum cleaners, sewing and washing machines, water heater, cooking stove and refrigerator—at the same time the electric pump is installed to pump water, to irrigate the land, to raise alfalfa, to feed the electrically milked cows in the electrically lighted barn.

Even so shortly as ten years ago each power company on the coast, except for a few "standby" agreements, was a self-contained unit, coming in contact with its neighbor only when it was necessary to scrap for business because of an invasion of territory by the ever extending pole lines. Then came a few interconnections. It was natural when the transmission lines of two separate companies crossed or came close together that the arrangements for "standby" service in case of breakdown should be extended to an inter-change of power when one company had a surplus which the other could use. Later there were instances where one of two companies, separated by a third, had electricity to sell which the second wished to buy, so the third company was brought in as carrier of the current between the other two and the foundation for a superpower zone was laid. And today it is possible to follow an unbroken transmission line from Albany, Oregon, southward through two-thirds of the width of the state of Oregon and the entire length of California to the Mexican line, a distance of over 1,200 miles.

This is the greatest transmission system in the world. Tributary to it are steam plants which burn oil, wood refuse from lumber mills and natural gas; and hydro plants operating under heads varying from 15 feet to half a mile. With a capacity of nearly 540,000 horse power in steam and over 1,100,000 horse power in hydro-electric plants, the output of this interconnected system for 1922 was over four and a quarter million kilowatt hours.

It makes a real pool of power. Into this pool the steam plants, in industrial centers, and the hydro plants in the mountains, pour their output. Out of it the consumers of the Pacific coast take what they want when they want it by the turning of a switch.

While the East has been talking, theorizing and making surveys for superpower and superpower zones, the Pacific coast has quietly proceeded to develop both. Its superpower zone generates one-tenth of the total electric energy annually consumed in the United States, and distributes it over power lines exceeding in length one-half the total railway mileage of America.

Before another year elapses this system will become still larger by the bridging of two gaps which separate Albany and the power plants around Puget Sound, and the length of the transmission line will then become 1,600 miles and the connected generating capacity nearly two million four hundred thousand horsepower. The annual output will by that time be six million kilowatt hours. Even then less

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than 15 per cent of the hydro-electric possibilities of the Coast states will be represented; 85 per cent have not yet been developed. When they are all developed—and they are 43 per cent of the total of the United States—the Coast states should rank industrially as high as the states of the Atlantic seaboard. Industry means energy and as the fuels increase in cost hydro-electric power cannot fail to become more and more in demand.

INTERCONNECTION has not been responsible for the power development of the West. Interconnections are merely mechanical means to an end. They do not solve the economic and financial considerations which must be solved before power is interchanged among a group of companies.

In 1918 a winter of unusually low rainfall placed California face to face with a power shortage which threatened seriously to curtail the output of its farms and orchards, its shipyards and industrial plants, the products from all of which were greatly needed during the war. There was no tie between power companies around San Francisco Bay and those around Los Angeles. The northern group, after trying among themselves to meet the emergency, went to the State Railroad Commission, and asked it to take control. A power administrator was appointed; to him was delegated whatever legal powers the commission possessed, while the companies stipulated that they would obey any orders and rulings he might make.

It was felt that the curtailment of power supplied to the less essential industries would be the important work to be done. The real work, however, was in coordinating the power plants of the companies themselves.

The Power Administration was continued for nearly three years after the war, operating as a board of trade through which wholesale buying and selling of power among the companies was conducted. The existing power was pooled, a superpower zone was established, but the full possibilities were not realized, and in any superpower zone they will not be realized, until the scheme of operation covers the full field and brings complete coordination of all the activities of the companies in the zone.

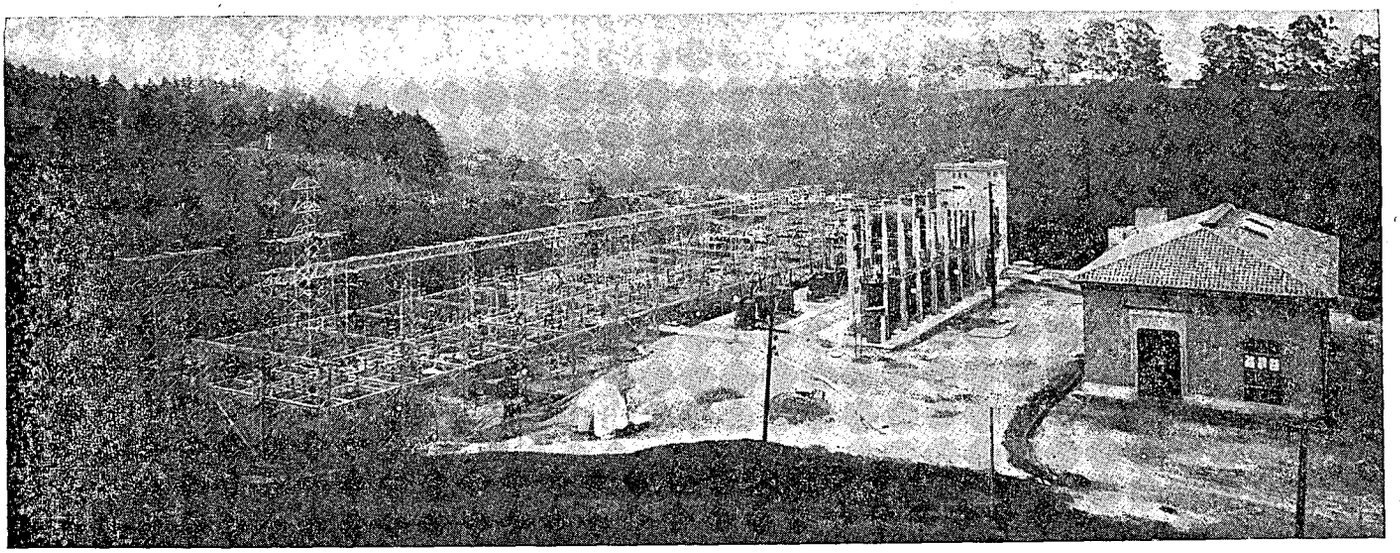
This matter goes as far as the financing and construction of future facilities. Regulation has not met the criticism that it does not reward cheap and efficient operation. It has established the principle of allowing in the rate all operating costs and a fair return on the investment, but it offers no inducement to a power company with an undeveloped project to purchase from a neighboring company, rather than make its own development at a greater cost.

The problem can be solved only in two ways: complete consolidation within a power zone, or regulation which covers the financial and construction program exactly as if consolidation had taken place.

THE Pacific coast states which have taken the lead in hydro-electric developments seem ambitious to take the lead also in solving this problem of consolidation by public ownership. In California, especially, the question was put squarely up to the voters in the election of November, 1922.

It came as a proposed amendment to California's shredded and patched constitution. A "Water and Power Board" of five members was to be appointed by the governor, empowered to acquire or construct any kind of property which in its opinion it was necessary or convenient for it to have in generating and distributing electric energy, and owning and distributing water anywhere in the state. Upon five days' notice it could take possession of any property it needed and of the need it was to be the sole judge. It could use the waters and lands of the state and contract with other states or the United States for power and water. It could require the reservation of water as long as it desired. Authority was given it to "manufacture materials and supplies, raw or finished," and "any property or thing" convenient to accomplish its purpose. The sum of five hundred million dollars was placed at its disposal, the principal and interest on which were guaranteed by the state and the board was to make power rates sufficient to cover them; but if the rates were not sufficient the deficit was to be made up by taxation. The state and political subdivisions were to have a preferred right to water and electric energy as against public utilities, and the board was required to furnish political subdivisions near the source of supply before more remote users.

To understand the psychology of the voters when this amendment was before them, it is necessary to go back a few years. The great growth of the power business has



At the sub-stations the power from the big high tension transmission lines is "stepped down", and adapted to the lines of local service

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PROJECT MAP OF

Based on Map by Frank G. Baum in Atlas

The western watershed has already given the Pacific Coast states power for over 1200 miles of interconnected electrial power systems (see page 605)

Network of transmission lines proiected to con

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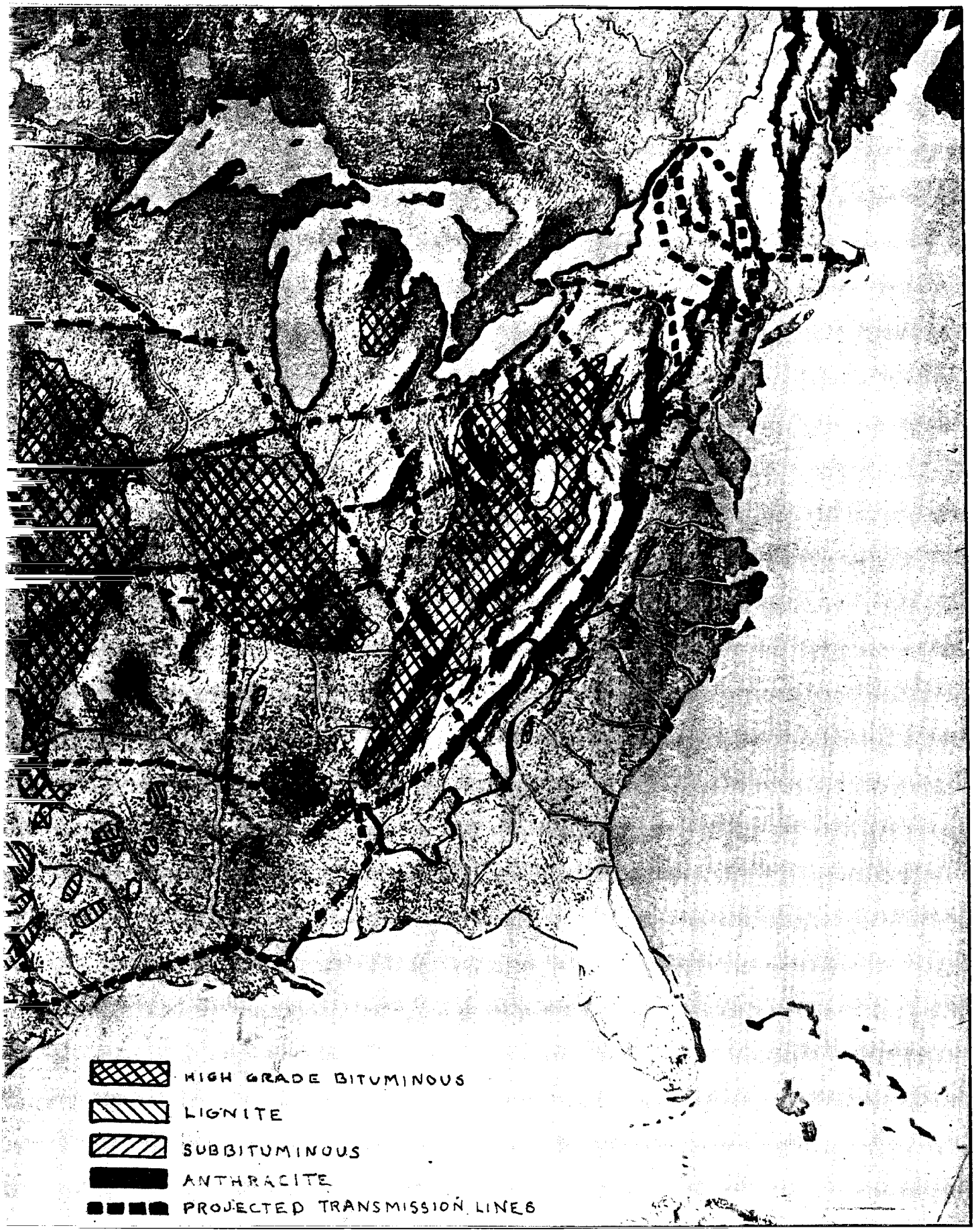

RICAL DEVELOPMENT

A. Electric Power Industry and Bacon's Relief Map

ing and projected systems and serve intervening areas

Bituminous coal and falling water are primary sources of Giant Power

(see pages 561, 569, 581, 601, 611, 613, 622)

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taken place under regulation, since 1911. The securities of the power companies had been passed upon by the State Railroad Commission. Their rates either had been or were being overhauled by the commission. Their service was under strict regulation. The power companies were also much in the public eye. The managements in harnessing the mountain streams by wholesale were justly proud of their accomplishments and lost no opportunity to tell about them, partly because it was a very human thing to do, and partly because they were selling securities to the California public, and it was good advertising. The commission was popular and the power companies were generally free from criticism. Then came the war with its mounting costs of labor and material, and in addition three years of abnormally short rainfall requiring large quantities of power to be generated on steam by the use of fuel oil costing four times the pre-war price.

The power rates previously established by the commission had to be increased from time to time by the addition of surcharges. The costs, however, went up faster than the rates, and after the war, when the tendency of prices was downward, power costs were still going up. The commission's popularity disappeared together with that of the power companies. The publicity which the power companies had secured for their developments and the stories of prosperity which had helped to sell their securities greatly aggravated the situation.

It became so serious that the state legislature of 1920-21 appointed a joint committee to investigate the practices of the commission. The committee was admittedly unfriendly in its attitude at the start, but it completely changed during the course of the investigation, and finally rendered a report wholly favorable to the commission.

THE investigation was helpful to the commission and might have been in the power companies, had not another matter come up. The state government of California is supported by taxes levied on the gross revenue of the public utility corporations. Up to 1920 the tax was 4½ per cent. The King bill introduced in the legislature proposed to raise this to 7½ per cent. The power companies immediately opposed it, while the governor and the administration backed it with the slogan—"The People vs. The Corporations."

The King bill passed after a bitter fight in which every voter was in one camp or the other.

As against all this the power companies were giving much better service than ever before and were striving harder to secure popular approval. Welfare work among the employes was organized. Both employes and consumers were urged to buy stock. One company has over 61,000 stockholders, twice as many as it had a year ago, 98 per cent of whom live in the state; 90 per cent of this company's employees are stockholders.

With strong friends and strong enemies, the entire state intensely interested in the outcome, and the voters having at the start a general knowledge of the situation, the Water and Power Amendment was the main issue of the election. The campaign started a year in advance. The mails were loaded with propaganda, and no town was too small to be overlooked by the speakers who toured the state. When the returns were in it was found that the Amendment was beaten two to one.

MEANWHILE the public ownership question has taken a new form. Los Angeles, the largest city, which owns several generating plants on its aqueduct line and a portion of the distribution lines within its borders, is now seeking to secure a complete monopoly.

San Francisco, the second city, is just completing an 80,000 hp. plant on its Hetch-Hetchy system and whether it will condemn the distributing systems of the city power companies and distribute its own power, or sell the output of the power plant to a utility company will probably be left to the voters.

Last spring, Oakland, Berkeley, Alameda and the smaller towns on the east side of San Francisco Bay, voted to form a Municipal Utility District, primarily for the purchase of the existing water company, but with an eye also to power. Finally, Sacramento voted to form a power district to take over and operate the properties of the two power companies within its boundaries, as well as to build a power plant of its own in the mountains.

One of the reasons for the movement towards municipal ownership in the cities is found in the tax established by the King bill. Under municipal ownership 7½ per cent of the gross revenue paid to the state by the power companies, as well as federal taxes, are saved to the rate payer. As municipal securities are tax exempt, the cost of money is cheaper to the municipalities than to the power companies. But the greatest saving comes in eliminating from the rate of the city consumer a certain amount he is paying to lighten the cost to the agricultural consumer; for while the farmer may be paying the actual cost of his service, he is not paying adequate return on the investment devoted to it.

None of these are fundamental economic reasons for a change from private to public ownership. A modification of the tax laws, and of public policy, would remove them. They are real factors, however; and in addition there is a certain dissatisfaction with existing conditions and a desire for change. It may wear out and disappear, although it will leave some traces behind it. It is not very deep seated, and compared with the full significance of the power development of the Coast, not of very great importance. Electricity is such a vital thing that the job of continuing its development cannot be permitted to stop and there is no reason why it should stop. The security holders of the power companies have not much to fear in any event. If the properties remain privately owned, under regulation, interest and dividends and bonds as they mature will be paid; if condemned, the full principal will be paid when they are taken over, because in the main the power companies of the coast have value behind all their securities, and they are dealing with a public which in the long run has no desire to treat them other than fairly.

For the development and interconnection of the pools of electrical power have brought a new era of comfort and prosperity to California and to the Pacific coast. Eighty-three per cent of the dwellings in California are wired against thirty-five per cent for the country as a whole. The average rate for electricity in California is 1.42 cents per kilowatt hour as compared with 2.17 cents for the United States as a whole and 2.82 cents for the New England States. These gains of large scale electrical development are so substantial that the people of California and the Pacific coast may be trusted to conserve them wisely and to make them a basis for greater developments in the future.

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In the Southern Appalachians

By JOSEPH HYDE PRATT
Director, North Carolina Geological and Economic Survey

CONSERVATION of water powers, unlike the conservation of any other natural resource, is by a maximum judicious use of them—the more water powers are used, the more valuable they become. Today water power development in the Southern Appalachian States means electric power. As we consider the vast amount of water power available, the thousands of sites capable of developing from a few hundred to several hundred thousand horsepower, we begin to realize the possibility not only of the intensified development of industrial plants, but also that of carrying to the domestic consumer in town and countryside the comforts and conveniences which many have supposed were available only in cities.

In some instances electrical power will be the deciding factor in maintaining a stable population in our rural sections and all that that means to states vitally dependent upon the increase of small self-supporting farm homes.

During the next decade the demand for power in the Southern Appalachian states is going to tax their water power resources to the utmost, especially for the larger industrial developments. These states are divided into the Coastal Plain, the Piedmont Plateau and the Appalachian Mountain Region.

The COASTAL PLAIN has been built up of unconsolidated sands, gravels, loams, clays, of recent geological age, and inland, it rests against the redlands and the sloping, rocky surface of the hill country, the eastern margin of the Piedmont Plateau. This contact between the two regions is known geographically and industrially, as the "Fall Line." Along it are located important cities and towns such as Washington, D. C., Richmond, Va., Weldon and Smithfield, N. C., Columbia, S. C., and Augusta, Ga., which are at the head of navigation of the streams on which they are located. On the seaward side of this fall line we have the sluggish, navigable rivers which make their way southeasterly across the Coastal Plane.

The elevation of the PIEDMONT PLATEAU near the coastal margin ranges from 300 to 600 feet. Toward its western margin, the hills rise higher and higher above the general plane until they develop fairly good sized mountains, some of which have elevations between 2,000 and 3,000 feet.

The APPALACHIAN MOUNTAIN REGION extends from Alabama to New York. The rugged mountain range on the eastern border is broken only by such occasional water gaps as those through which flow the Susquehanna, the Potomac, the James.

WEST OF THE MOUNTAIN region in Tennessee and Kentucky, the area between it and the Mississippi River corresponds closely to the Piedmont Plateau. The annual rainfall is 50 to 60 inches along the coast, 40 to 50 inches in the Piedmont Plateau to 70 and 60 inches in places in the mountain region.

"Out of the Hills of Habersham"

The pioneer scanned his country. His children and grandchildren grew up in it, and took it for granted. Mr. Pratt heralds the new pioneering of the South in which loams and clays, redlands and hill country, "fall lines," water gaps, and rain falls all must be reckoned with over again by a new generation if it is to make the most of the Piedmont plateau, of mountain country and coastal plain. A believer in private developments, he tells of interconnecting power companies, of municipal enterprises springing up on many sides, and especially of his vision of the industrial village of the future surrounded by a settled farming community of the future – both served by electric power.

The two conditions essential to the development of a water power of any considerable magnitude are a large and fairly constant flow of water, and a suitable amount of fall within a reasonable distance, and it is in the Piedmont Plateau that we find the most satisfactory combination of these two essential conditions. In this same region we find the largest water power developments and the greatest and most substantial developments for manufacturing interests.

The following table shows estimated total potential water power, without storage, in the Southern Appalachian states:

State	Minimum		Maximum		Installed capacity of water wheels
	Horse-power	Percent of total in U. S.	Horse-power	Percent of total in U. S.	
North Carolina	578,000	2.07	875,000	1.62	450,000
Alabama	509,000	1.82	943,000	1.74	260,000
Virginia	492,000	1.76	870,000	1.62	157,000
Tennessee	463,000	1.66	761,000	1.41	222,000
South Carolina	460,000	1.64	677,000	1.26	453,000
West Virginia	381,000	1.36	1,051,000	1.95	20,500
Georgia	374,000	1.34	627,000	1.16	342,000
Kentucky	83,000	.30	197,000	.37	14,000
Mississippi	32,000	.11	63,000	.12	8,500
Florida	8,000	.03	13,000	.02	11,000

The water power estimated can be largely increased by storage, and in some instances the maximum power with storage would be doubled or trebled. To say that a state possesses 1,000,000 hp. in potential water power however does not necessarily mean that this power is commercially available. Often a considerable portion cannot be economically developed under existing conditions, or those likely to exist in the near future. On the other hand, a considerable amount of potential power is contained in small streams, the development of which in the next ten years will undoubtedly be economical and commercial.

The southeastern area is now served by 12 large power companies, whose interconnected systems have a capacity of more than 1,200,000 hp. Of this power, 800,000 hp. is hydro-electric and 400,000 hp. steam. Of this power 8.2 per cent is used for residential purposes, 7.6 per cent for railways and 84.2 per cent for industrial purposes, namely, cotton mills. On the chart, page 612, the annual output of electric power for the principal power producing states for the years 1907 to 1922 inclusive, is given in millions of kilowatt hours. There is also given for

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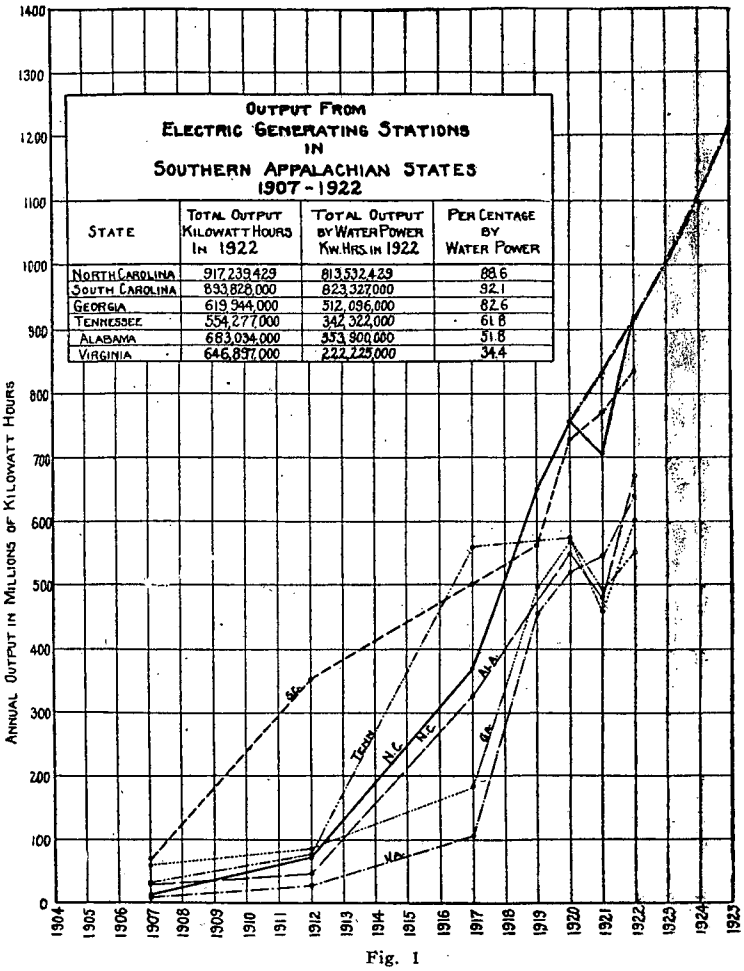
the year 1922 the total output of power and the output by water power.

The demand for water power throughout the region is considerably in excess of the supply. Many progressive municipalities are becoming seriously concerned at seeing industries located elsewhere and the growth of their own cities retarded by lack of power. Some are contemplating municipal development of water power sites. Today the initial expenditure for the construction of large dams on these sites, power houses and transmission lines is so great and the return on the investment is often so small that they do not attract private capital; but it is held that the municipalities can afford to enter upon such developments with the expectation that the difference between what the municipal plant would earn and what stockholders in a private corporation would demand will be offset by the benefit accruing to the municipality through the possession of power which it can offer industrial plants, and which, in turn, would add to its revenue and property. For example, in North Carolina the State Survey has made an investigation for the city of Fayetteville of a such a water power of approximately 30,000 hp.

Such power developments should be interconnected with other systems wherever possible, so that their most efficient and economic development and utilization can be realized. To what extent municipalities should be encouraged to own hydro-electric or steam electric plants is questionable; but the primary public concern is to secure the most wide-spread and most satisfactory service at the least price to the consumer, and if public ownership by municipalities or even by states can accomplish this by honest competition, then the municipalities and states are justified in operating and owning power plants.



STATE	TOTAL OUTPUT KILOWATT HOURS IN 1922	TOTAL OUTPUT BY WATER POWER KW. HRS. IN 1922	PER CENTAGE BY WATER POWER
NORTH CAROLINA	917,239,429	813,532,439	88.6
SOUTH CAROLINA	833,826,000	823,327,000	92.1
GEORGIA	619,944,000	512,096,000	82.6
TENNESSEE	554,277,000	342,322,000	61.8
ALABAMA	663,034,000	353,800,000	51.8
VIRGINIA	646,857,000	222,225,000	34.4

Fig. 1

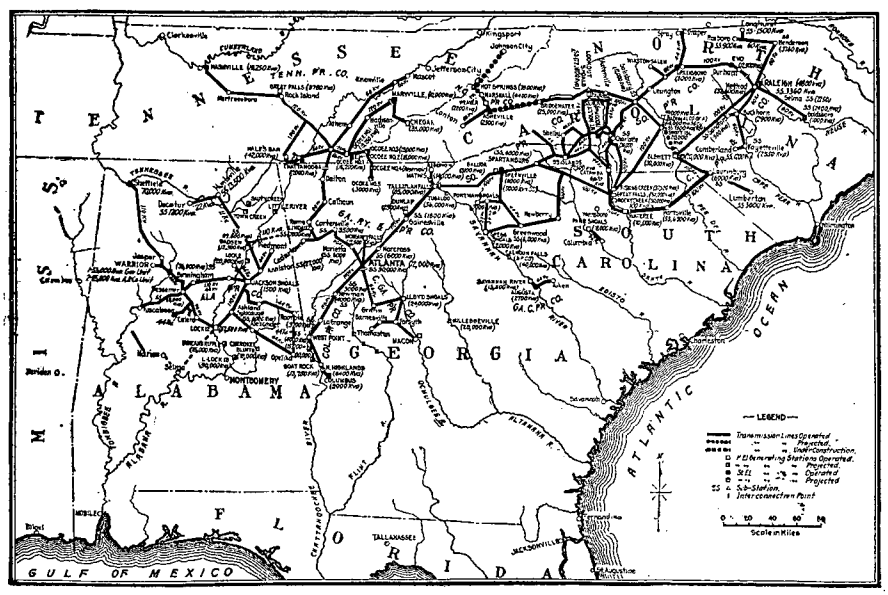
This chart was prepared by Mr. Thorndike Seville, Hydraulic Engineer of the North Carolina and Economic Survey

Rise in output of electricity during the last twenty years in the Southern Appalachians

Many public men and politicians who are advocating public ownership of water powers are grossly ignorant of the subject; and in several states legislation has been passed without working out costs sufficiently; with result that these have proved to be nearly double the estimates. Cheap power is desirable, but it is my belief that with proper regulations, such as are in force under the Federal Power Commission and the several State Power Commissions, the power companies can furnish power, in most instances, cheaper than by state or federal ownership.

Beyond the physical facts of enough water falling a sufficient amount in a short distance, the need for a sufficient investment for proper control, and adequate regulation in the public interest, a hydro-electric project is successful in direct proportion to the continuous operation of all its hydraulic installation. Here the availability of water afforded by the proper development and the use of storage to supply the deficiency of periods of low water both enter in. For example, the North Carolina Geological and Economic Survey is investigating the Deep River upon which there are already several power plants, to determine if it can be developed into a self-sustaining and coordinated power area. The head waters are being studied in regard to undeveloped sites and to the establishment of storage

(*Continued on page* 654.)



Power lines interconnecting in the Southern Appalachian states link together the different watersheds

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Woodcut by J. J. Lankes from drawing by Charles Burchfield

Carolina Village

Idle Slaves in the South

By MARION M. JACKSON

POWER, equal in labor energy to more than 75,000,000 men—over five times the Negro population of the United States—is idle in the streams and rivers of the South, because undeveloped. This water-power, together with her coal and oil fields, gives the South a combined potential power greater than that of any other part of the world. Yet today, in proportion to population served, no other section of the United States is so poorly served in the distribution and use of electricity.

The manufacturing plants of the South cannot get enough electric current to operate. Their installed primary power in 1919 was 5,396,660 horsepower. Of this, only 1,416,897 horsepower was electric, supplied by power companies.

Factory and mill are forced to use costly steam.

Noting the increase in textile mills—the cream of the power business in the South—the Southern Railway's "Textile Directory" says that this progress has accompanied the development of hydro-electric energy derived from numerous streams, which now produces the power that drives more than 4,000,000 spindles.

But over twice 4,000,000 spindles are in the mills of the two States of North and South Carolina alone—more than three times that number, namely 15,964,381 spindles, are in the southern states. And, only last October, it was announced that a number of the few plants which depend on electricity for power in that section of the South Atlantic states, much advertised by the power companies as being wonderfully served by their interstate and intrastate "super power system", must curtail their working week to five days because the power companies could not supply sufficient current.

Progress is wholly relative. And the effect of this shortage of developed power is seen in the industrial growth of the South, when it is compared with that of other sections, where man power is multiplied by machinery driven by electricity.

The number of manufacturing plants in California, with her abundance of developed waterpower, increased 4,083 in the ten years ending with 1919; in the

A Georgian's Challenge

HERE we have the call of a Southerner to his own. Here he pictures "great reaches, rich in water power and natural resources, marked by lightless homes and primitive industrial methods, producing illiteracy and stagnation, where Americans of the purest strain are living under conditions approximating those of the Middle Ages."

He draws in the gaunt farm woman lifting daily her ton and a half of dead weight; private power corporations "hoarding, by holding them idle, the great bulk of water power in the South"; the manufacturing districts of the North with their higher power development drawing away her labor, white and black; California with electrically served farms worsting her rice crop; national schemes of power transmission threatening to drain her hills of energy while she sleeps. His is a plea for the people of the South to rise and claim their heritage.

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eight Middle Atlantic and East North Central states, during the same time, the increase was 8,364; but in the south, the sixteen South Atlantic, East South Central, and West South Central states, the increase was only 2,732. Of this number—most significant—2,000 and more are found in two states, Texas with her oil fields, and North Carolina, in which last mentioned state more electricity is used in manufacturing than in any other strictly southern state.

The struggle to overcome the handicap imposed by this lack of developed power is indicated by the many municipal electric light and power plants in the south. There are 675 of these, 330 of them being in the South Atlantic states, which states are supposed to be so marvellously served by the power companies' "superpower system."

A few of the 675 municipal plants—notably in twenty-five counties of North Georgia (in which state are approximately 110 counties, where a transmission line bringing power generated by waterpower has never been seen) buy their current at wholesale from the power companies, and sell it at retail to the homes, stores and industries of the municipalities. But the great majority of such plants are steam driven, built by towns and villages, not because they prefer public ownership and operation, but because they have been unable to get light, and a measure of power in any other way.

DEBT limitations have made it impossible for most of these communities to finance the municipal development of waterpower. Lack of legal machinery, if not express prohibitions, prevents their combining either for this purpose, or for the purchase of fuel. Forced to use the steam plant, which is cheaper to build, but far more expensive to operate, they must endure the fluctuating and ever mounting price of coal shipped by freight hundreds of miles to hundreds of different places.

The cost of current so generated makes it impossible for them to keep pace in industrial growth with more fortunate municipalities supplied with electricity generated by waterpower. The great proportion of their population cannot afford to use the current even for light in their homes.

But their lot is more fortunate than that of the majority of the people of the South.

According to figures published by the United States Census Bureau in 1920, out of a population of more than 33,187,532 in the South Atlantic, East South Central, and West South Central states, some 22,720,527 people live where they cannot get electricity from any source at any price.

Great reaches, rich in waterpower and natural resources, are marked by lightless homes and primitive industrial methods, producing illiteracy and stagnation, where Americans of the purest strain are living under conditions approximating those of the Middle Ages.

THEIR homes may be on hill sides, where red gulches scar and mark the earth; or in green mountain valleys, which with laurel and rhododendron, and rippling streams, seem glorified Edens in the sunset's golden glow; or on great flats toward the sea, such as those ending in the Marshes of Glynn—vast levels, tracked by the turpentine farmer and the lumber man, leaving in their wake, along the edges of fields, stark ghosts of pine forests, denuded of their beauty and transformed into row on row of charred and ghastly swamps, in a wilderness of scrub and swamp.

The houses may be built of logs—two rooms flanking a passage-way, open at both ends to wind and weather—a shackly shed leaning against the wall. Or they may be gaunt things of unpainted boards, gray with a grayness like to that of the moss in the neighboring swamp.

Whatever the type, in home after home will be seen a baby crawling or lying on the rough board porch, where listless children are grouped, the little variation in their size suggesting a stairway, and telling of the closeness with which one followed the other into the world.

They were born tired.

Their thin little shoulders were burdened with the weariness of the mother before she gave them birth.

She is the woman bowed over the rusty stove within.

Her face is sallow and lined, her hands calloused and gnarled. Her shoulders sag, and her back bends beneath an invisible but ever present burden.

Before the dawn, she has fed and milked the cows. She has set aside the milk to cool. Kindling the fire, she has cooked a soggy breakfast for the husband and her little brood. She has churned. With creaking windlass, or sweep, she has drawn bucket after bucket of water from the well. She has washed the clothes. A garden patch has been hoed, raked and weeded by her.

Now she cooks dinner. Later, carrying the baby, she will go to help in the fields, while the baby will sleep in the shade of a nearby bush. At dusk, she will creep back to feed the cows and milk again.

At night, in the light of a reeking lamp, filled by her, her stiffening fingers will ply the needle, while she follows the seam with sleepy, peering eyes, to clothe the children, who, if they live, when grown, weakened in brain and bone, will slip away to the city to escape the darkness and drudgery, which have caught and crushed this girl in years, and transformed her into this woman, old and worn, the mother of the handicapped.

She could scarcely believe that in the brawling brook and murmuring river is a power which would light her home, milk her cows, churn the butter, draw the water, make, mend and wash the clothes, sweep the floors, split the kindling and cook the food.

The average farmer's wife, it is said, lifts and carries daily, in the relentless grind of her life, one ton and a half of dead weight, chiefly the water which she draws. One ton of water, falling a foot in one second, will generate more than four horsepower, equivalent in labor energy to forty-eight men.

MILLIONS upon millions of tons are daily lifted from the seas by the sun. Wind-blown clouds, bringing the waters and breaking upon the mountain tops of the South, send hurtling down her water courses millions upon millions of slaves, in their uproar offering to serve, waiting only the command of man to work without ceasing in lifting the darkness and drudgery from the homes of men—slaves capable of working not one wonder once in a single home, but a myriad of miracles, a myriad of times, in countless fields, factories, and homes, at the touch of a button.

Their idleness—the failure to use this power to lift the burdens from bending backs and sagging shoulders, and to drive from homes the darknesss and drudgery, now barring

(*Continued on page* 655)

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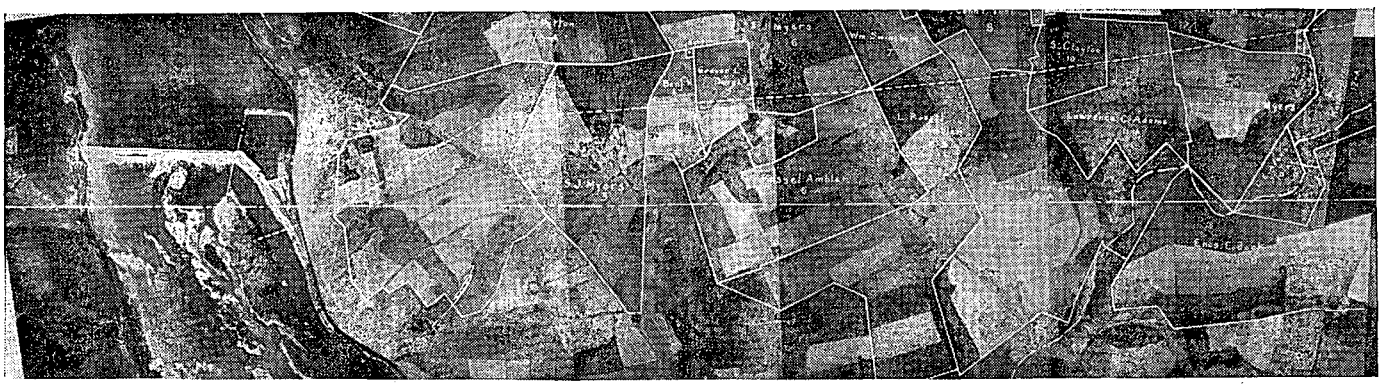

Courtesy of the Fairchild Aerial Camera Corporation.

This section of an aerial mosaic map, made for the Pennsylvania Water and Power Company, shows how, after the map was assembled, title searchers plotted in the white property outlines and lettered the names of the property owners, enabling the company to save considerable time in the purchase of the right of way. The straight line through the center of the property was the line furnished the aerial mapping company as the center of the area to be included on the map. The dash line with several angles, was the route of the projected transmission line which was laid out in the office on the photographic map

Aerial Maps

MAPS composed of aerial photographs snapped some three miles up in the air are comparatively new. After the war, the United States War Department began using airplane photographs from which details were traced to line maps familiar to all engineers. Gerard H. Matthes, consulting engineer, formerly assistant engineer in charge of the Tennesse River project where aerial mapping on a big engineering project was first given a trial by the government, writes that from the start:

> Aerial photographic mapping . . . . exceeded all expectations. Photographs were taken with special aerial mapping cameras made by the Eastman Kodak Co. and the Fairchild Corporation, both American concerns, from airplanes flying at altitudes determined to give pictures closely to the desired scale of the final map. The scale selected was 1:15,000, equivalent to 1,250 feet to 1 inch. This required making exposures from altitudes of 2½ to 3 miles above the ground. The accompanying illustrations are good examples of the better grade of pictures obtained.

From these aerial photographs the War Department engineers secured the necessary data for compiling line maps used in the study of projects for the development of the water power resources of the Tennessee River.

Then came the development by Sherman M. Fairchild of New York, of the mosaic map which brought increased accuracy and combined the many advantages of the vertical aerial photograph with engineering precision.

The Fairchild company is a young organization, its president still under thirty. Several years ago, he saw the possibility of the usefulness of aeroplane pictures in connection with map making, provided the proper equipment was available and a greater degree of care, accuracy and precision could be secured in the flying of the aeroplanes. In other words, it became necessary not only to construct a special camera with which to map from the air at a scale of, for instance, 1000 feet to 1 inch with a lens having a focal length of twelve inches, flying at an altitude of 12,000 feet, but it also became necessary to select pilots who possessed the daring and experience so necessary to that profession, yet with the ability to curb their exuberance and be willing to make every effort to obtain the same precision in flying that the engineer requires on the ground. Such a lens with a shutter opening of three inches and with a speed of 1/150 of a second is used in this new camera.

One of the problems solved by Fairchild was the development of the between-the-lens shutter, long considered impossible but most desirable. Cameras embodying this important feature are now manufactured in quantity and are being supplied to the U. S. Army and U. S. Navy air services as well as the Brazilian and Canadian governments.

When the wind blows hard, an airplane cannot hold its course to a straight line at a given altitude. And also, if a man were to hold himself to a given altitude above sea-level, he might find himself bumping into a mountain. Thus, the aviator, in taking the individual parts of the map with his camera, knows that the scale varies to a certain extent.

The pictures taken by expert photographers are handed to engineers and are brought to scale by enlarging or reducing them, as the need may be. These photographs are then joined together—and the result is a map without mystery to the layman, and a particularly useful instrument to the engineer.

As a rule, the mere sight of civil engineers with transit and chain, going over a farmer's land, has meant a gathering of neighbors and consultation about sale prices of whatever plots of ground might be needed by the company for its right of way. An airplane overhead causes no such deliberations, but the camera man in the air can make a map, like that at the head of the page, where an area of desired size is laid out accurately, showing every farmhouse, barn, cemetery, or other landmark that must be avoided in building high transmission lines. Cemetaries, which are protected from condemnation under "eminent domain," present impassable obstacles in projecting transmission lines. So one of the first questions asked of the aerial map makers is, "Will your maps indicate cemetaries?" All preliminary searching of titles to the right of way also can be done before the owners are approached, and with the aid of the airplane map, the right of way can be laid out with the least possible waste of time. One power company estimates a fifty per cent saving of time and money.

S. M.

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AIRPLANE PHOTOGRAPH TAKEN BY U. S. ARMY AIR SERVICE FOR TENNESSEE RIVER PROJECT

The large stream is the Upper Clinch River and the other is its main tributary, the Powell River. Through the building of large reservoirs on these streams it will be possible to double the primary (steady) water power available in the Tennessee river as far down as Muscle Shoals

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A BEND IN THE TENNESSEE WHERE THE RIVER IS A QUARTER OF A MILE WIDE

The locality at the ferry, known as Rockwood Landing, was at one time an important shipping point for iron ore, and will regain its lost importance when the river is made navigable through the building of power-navigation dams

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Appalachian Power

Servant or Master?

By BENTON MACKAYE

WHAT shall we do with our power when we get it?

We are harnessing up a team of giants—a black giant called "coal" and a white giant called "waterpower." The strength of these giants has been measured on the basis of data collected by the U. S. Geological Survey. The minimum flow of waterpower in the Eastern States is estimated at 5,768,000 horsepower; the minimum continuous "flow" of coal power, assuming 500 years as the period of use, is estimated at 9,102,000 horsepower.

Will these giants be our servants or our masters? This depends:

If we make them turn a wheel instead of turning it ourselves then they will be our servants. If they make us turn a wheel for every one that they turn then they will be our masters. Power is capacity for doing work but it will not of necessity free us from work unless we use our wits about it.

But do we want to be "free" from work? That again depends:

If "work is a curse," as the late Dr. Steinmetz has said, then we should have the minimum of it. If "work is a joy," as President Eliot has so often said, then we should have the maximum of it. Now it is evident that these men are referring to two distinct things: one is referring to drudgery and toil, the other to creative interest and pursuit. How shall we use our pair of giants—coal and waterpower—to reduce toil and enlarge pursuit?

This is too long a story for one short article. All we can do is to hint. This is the second hint by the present writer. The first hint appeared some two years ago in an article outlining the so-called "Appalachian project."*

This big question (of reducing toil and enlarging pursuit) is a problem in two kinds of efficiency: one kind—industrial efficiency— is converting resources into "wherewithal" with the minimum of toil; the other kind—social efficiency—is converting wherewithal into the maximum of "pursuit," of "joy," of human welfare.

Industrial efficiency is a matter of cutting out waste motion. This is possible, so far as power is concerned, by "stretching the power belt" (to use the vivid analogy of Philip Wells). In years past the coal had to be taken to the factory, or else the factory taken to the coal seam. For the old leather power belt connecting steam engine and spindle (or lathe or buzz saw) was only a few feet long.

An Appalachian Trail: A project in Regional Planning. By Benton MacKaye. Journal of the American Institute of Architects, October 1921.

"Work is a curse."
Steinmetz.

"Work is a joy."
President Eliot.

"Power is a rate of work."
Technical definition of mechanical power.

But now, in the 300-mile electric transmission wire the power "belt" is that much lengthened: the steam can be raised at the coal seam and the factory placed where it may.

Social efficiency is not a matter of motion at all. So far as our particular problem is concerned it is a matter chiefly of developing an efficient environment. This requires of a community a number of things:

It requires (1) that the community's work be self-comprehensible, and (2) that it utilize modern industrial mechanics; it requires (3) that the community's population be of democratic proportions and (4) of a distribution attaining compactness as against both isolation and congestion; it requires (5) that the community have ready access to such natural attractive environs as much of our rural countryside provides; (6) that the community utilize modern sanitation (including smokeless factories); (7) that the community should be a unit.

These seven requirements occur in two quite distinct types of American communities. The old colonial type (which in part still exists) combined all but two of them. It lacked modern mechanical device and also modern sanitation (though its factories, water driven, were smokeless). The other type of American community—the modern commercial type—embodies the virtues of up-to-date mechanics and sanitation, but is lacking in the other five requirements of the efficient environment.

Both of these community types have been failures in the yielding sufficiently of ultimate human values, but each has the elements of success. The new has mechanical invention; the old has simplicity and self-comprehension; it is the union of these elements of the present and the past which is the big bright hope of the future. And the key to this union is a matter very largely of the proper application of our modern wizard—harnessed power.

These two types of American communities represent two distinct trends in our civilization. And corresponding roughly to these types—and trends—there are two zones of American life. One zone, representing the commercial trend, is made up of the various metropolitan areas; this (in the East) is most highly developed in the super-populated belt lying between the cities of Boston and Washington. (This is part of the so-called "superpower belt"). The other zone, representing what we may call the "colonial" trend, consists of the rural areas; and this (in the East) is most highly developed in the sub-populated belt lying along the Appalachian Range of mountains from Maine to Georgia.

This Appalachian belt of country forms a very significant portion of American territory. It consists of the wild and still undeveloped lands along and between the ridges of the

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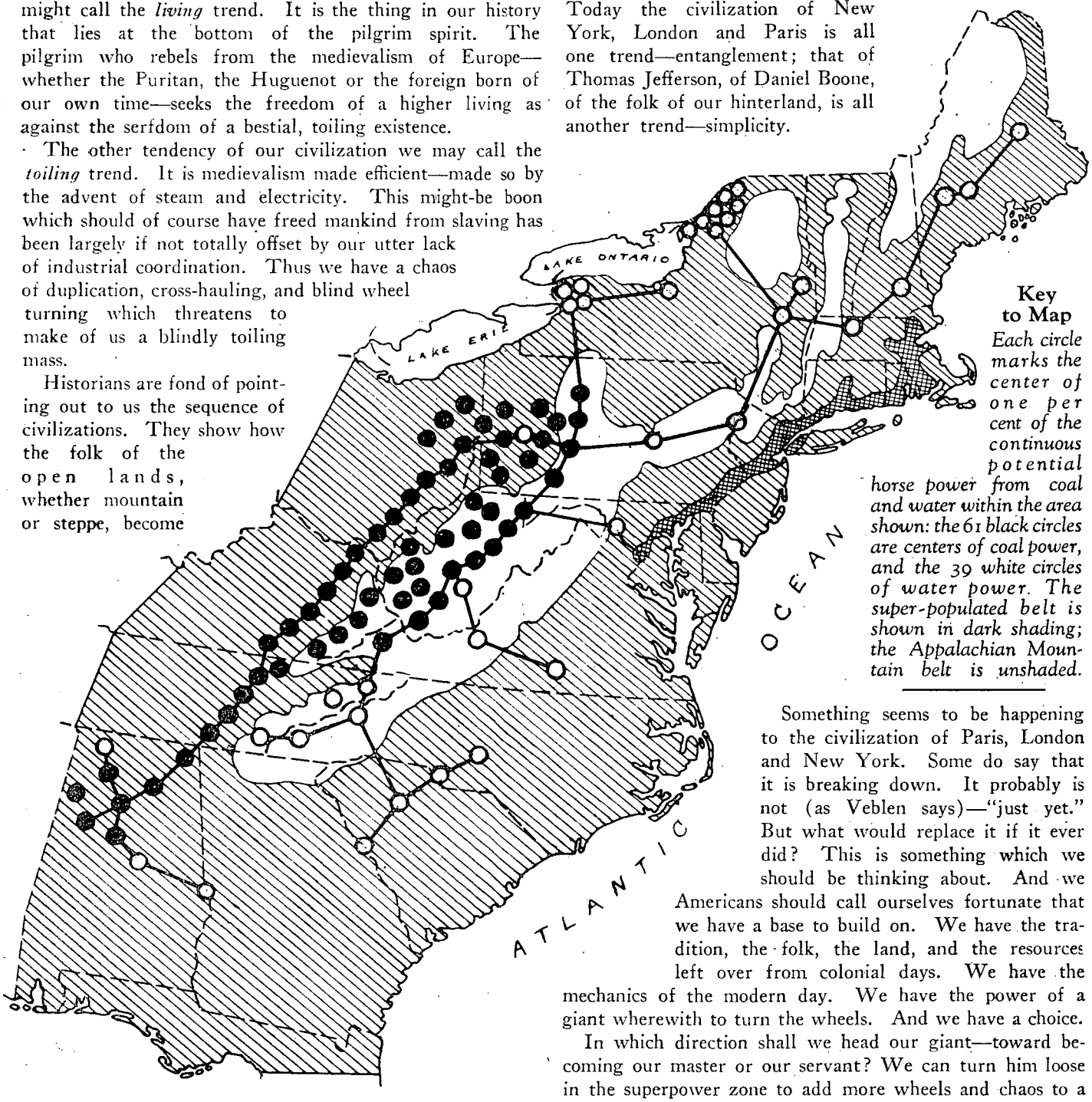
eastern continental barrier. This belt of undeveloped (or underdeveloped) land penetrates the most populous portion of the United States. Its people, especially those in the southern mountains, are of the purest form of original American Anglo-Saxon stock. Its traditions are those of colonial America and of Elizabethan England rather than of modern New York or Paris.

One trend—one tendency—in American civilization we might call the *living* trend. It is the thing in our history that lies at the bottom of the pilgrim spirit. The pilgrim who rebels from the medievalism of Europe—whether the Puritan, the Huguenot or the foreign born of our own time—seeks the freedom of a higher living as against the serfdom of a bestial, toiling existence.

The other tendency of our civilization we may call the *toiling* trend. It is medievalism made efficient—made so by the advent of steam and electricity. This might-be boon which should of course have freed mankind from slaving has been largely if not totally offset by our utter lack of industrial coordination. Thus we have a chaos of duplication, cross-hauling, and blind wheel turning which threatens to make of us a blindly toiling mass.

Historians are fond of pointing out to us the sequence of civilizations. They show how the folk of the open lands, whether mountain or steppe, become comfortably settled on the plain, and finally within the gates of the walled city. It may be on the Euphrates or the Tiber. Their comfort dissolves gradually into luxury and poverty. Then other folk of the open lands seize their civilization, new healthful blood is thus infused and the human world is better for it.

Alas, there are not sufficient of Appalachian Goths to seize our modern Rome on the North River! But there may be sufficient of old time Americans, and of recent pilgrims among the foreign born, to note the difference between the Commercial and the Colonial America. The Colonial America, as we know it in tradition, was a protest against Europe and its growing entanglements. Its ideals of freedom formed the germs of a separate civilization. But America, largely, became Europeanized. Today the civilization of New York, London and Paris is all one trend—entanglement; that of Thomas Jefferson, of Daniel Boone, of the folk of our hinterland, is all another trend—simplicity.



Key to Map

Each circle marks the center of one per cent of the continuous potential horse power from coal and water within the area shown: the 61 black circles are centers of coal power, and the 39 white circles of water power. The super-populated belt is shown in dark shading; the Appalachian Mountain belt is unshaded.

Something seems to be happening to the civilization of Paris, London and New York. Some do say that it is breaking down. It probably is not (as Veblen says)—"just yet." But what would replace it if it ever did? This is something which we should be thinking about. And we Americans should call ourselves fortunate that we have a base to build on. We have the tradition, the folk, the land, and the resources left over from colonial days. We have the mechanics of the modern day. We have the power of a giant wherewith to turn the wheels. And we have a choice.

In which direction shall we head our giant—toward becoming our master or our servant? We can turn him loose in the superpower zone to add more wheels and chaos to a headless commercial tangle; or we can conserve his strength to upbuild a hinterland in the original molds of a purposeful life. We can use him to huddle our people further in the grimy congestion of our urban wildernesses; or we can get him to start us on a new frontier. We can use him further to extend and ensnarl the toiling Commercial America, or we can get him to restore and revitalize the ever living Colonial America.

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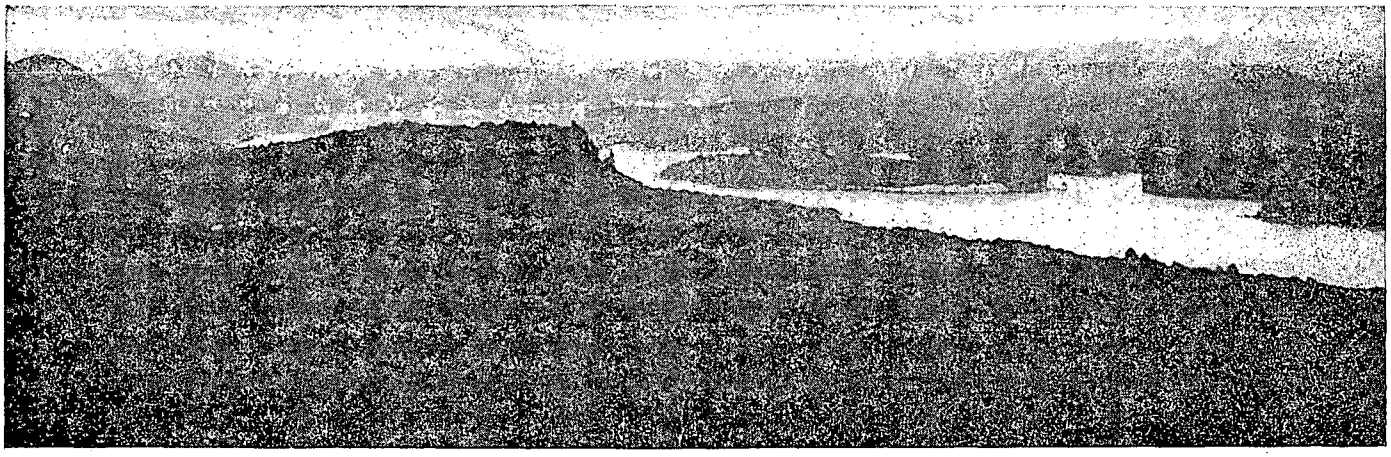

Well forested areas protect the storage of water in lakes and streams

Forest and Stream

By GEORGE D. PRATT

"God has lent us the earth for our life. It is a great entail. It belongs as much to those who are to come after us as to us, and we have no right by anything we do or neglect, to involve them in any unnecessary penalties, or to deprive them of the benefit which was in our power to bequeath!"

RUSKIN well says that the earth has been *loaned* to us for our safekeeping. How well—or how poorly—have we kept this trust? Our forests are denuded; our coal lands fast diminishing; our oil supply growing less.

Professor J. C. White, state geologist of West Virginia, in his address at a conference of governors some years ago, said:

What will it profit this nation to have won the wealth of industrial supremacy, if, in our thirst for gold and sudden riches, we permit corporate greed, as well as individual avarice and selfishness to waste and devastate the very sources of our prosperity? For just as sure as the sun shines, and the sum of two and two is four, unless this insane riot of destruction and waste of our fuel resources which has characterized the past century shall be ended, our industrial power and supremacy will, after a meteor-like existence, revert before the close of the present century, to those nations that conserve and prize at their power value, their priceless treasures of carbon.

Professor White's statement is equally true of our forests, and we may well wonder when this generation will awaken to its obligation to posterity! Surely we owe something to those who are to follow us, and if we consume all that nature has blessed us with, we should at least find a fitting substitute, so as not to leave them destitute.

When the first settlers peopled this country, they found a land rich in natural resources, immense forests abounding in fish and game. The supply seemed inexhaustible. But let me quote Circular 112, compiled in 1920 by the U. S. Department of Agriculture:

The original forests of the United States are estimated to have covered 822 million acres and to have contained 5,200 billion board feet of timber. Over two-thirds of this area has been culled, cut over or burned. There are left today about 137 million acres of virgin timber, 112 million acres of culled and second-growth timber, large enough for sawing, 133 million acres partially stocked with smaller growth, and 81 million acres of devastated and practically waste land. We have 463 million acres of forest land of all sorts which contains about 2,214 billion feet of timber of merchantable sizes. *Three-fifths of the timber originally in the United States is gone.*

Of course, these untouched forests occupied lands that had to be used for farms, and so the colonists applied the hatchet with a free hand. This, while it served one purpose, was a slow but progressive encroachment on the forested areas.

Reforestation

DRIVES have repeatedly been made by power promoters on our National and State parks. For example, upstate companies got bills through the last New York legislature which not only would have let them into the Adirondack reservation but would have enabled them to tap every lake within its borders. Friends of the forests rose in defense and defeated the bill on referendum last fall. But in the long view, hydro-electric development and reforestation need not clash: they may become parts of a broad program of conservation of natural resources. For those who think of our forests simply as sources of wood supply, Mr. Pratt draws another picture—of forests as sponge-like reservoirs of which concrete dam and rushing spillway are but symbols. Devastate the forests by fire and unscientific cutting and you dry up the sources of water power. The former Conservation Commissioner of New York here advocates federal expenditure before it is too late, and on a scale the public has not yet visualized, for conserving existing growth and reclaiming denuded forest lands. "Four and a half times more lumber is being cut each year than is being grown."

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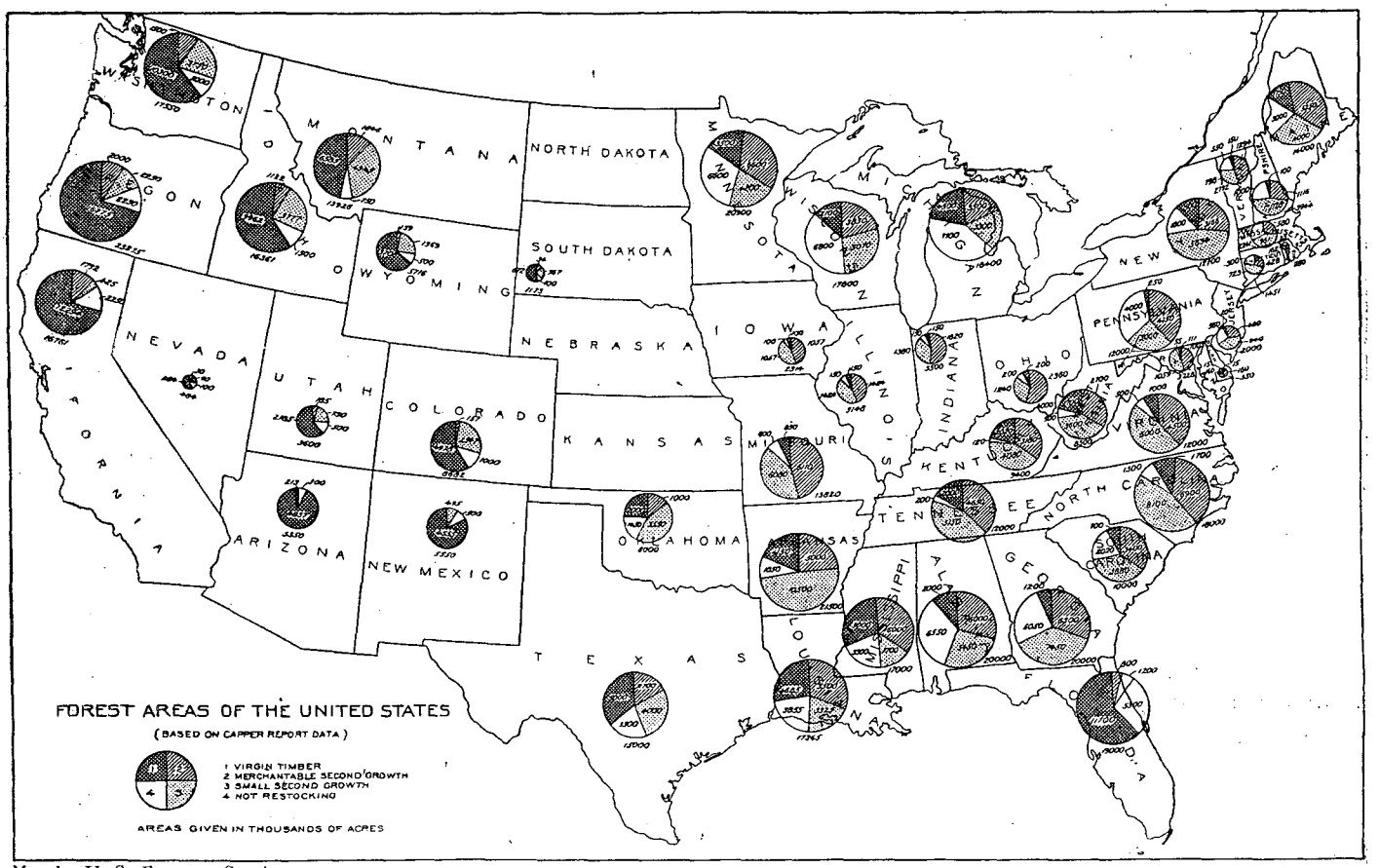

Map by U. S. Forestry Service

In this map is shown the original amount of forested areas with the gradual diminution through timber cutting and fires. It gives a graphic view of how our wood supply has been depleted. At the rate timber is being cut fifteen or twenty years will see the areas indicated by No. 1 on the diagram replaced by No. 4

Wood, in those early days, was used exclusively, not only for buildings, but for household utensils, farm implements and many other things for which we have since substituted steel or cement.

Newspapers which were then printed on paper made from rags, grew with the growing cities and increased population, in numbers and size of editions. With the discovery that newsprint paper could be made from wood pulp, this industry has made one of the largest drains on our forests. It is estimated that American daily papers reach 40 million people, and to supply them, the pulp mills, like hugh dragons, demand our forests as their feed. Between their stone rollers, like two monster jaws, the log of wood is placed, and crushed to a pulp. When you realize that it requires *ten acres* of spruce timber to produce enough paper for the Sunday edition of a single metropolitan paper you can have some idea why our forests are diminishing so rapidly.

When our young married people contemplate erecting a home they are met by the high cost of building materials. Even a small wooden house built in the country costs at least five times more than it would have cost ten years ago. Why this increase? Because the forests in our eastern states have been so depleted that the greater part of the saw timber now comes from the states of Washington, Oregon and California. This 3,000 mile haul adds materially to the cost of the lumber.

The problem in forest depletion, therefore, is not alone that of quantity but of availability. To quote again from the U. S. Department of Agriculture (Circular 112) this is

partly shown in the cost of transporting the average thousand feet of lumber from mill to user. Prior to 1850 when the great bulk of our lumber was manufactured near the points of use, the transportation cost averaged less than $3 per thousand board feet. Today it is probably $10. In another decade, at freight rates now prevailing, it will reach $15 per thousand feet. But aside from rising freight costs, the exhaustion of nearby supplies of timber imposes upon the consumer all the disadvantages of being dependent upon distant and restricted manufacturing regions. These include congestion of transportation, the effects of labor shortages and bad weather in limited regions, and a narrowed field of competition.

A fire tower

Our newspapers have all increased their charges to the reader. Why? Because of this increased scarcity of raw material. Most of our pulp wood comes from Canada, and the manufacturer of newsprint paper, driven further and further for his supply, fears an embargo on the shipments from across the border. The last district belonging to the United States is now being tapped. I refer to Alaska, where the government has just granted to two lumber companies long leases covering a period of years. This section fortunately is one in which reforestation is natural, so that if conservative methods are carried on, the supply should last for a long time. But Alaska cannot furnish the amount of pulp wood needed to fill the demand; it can only add its

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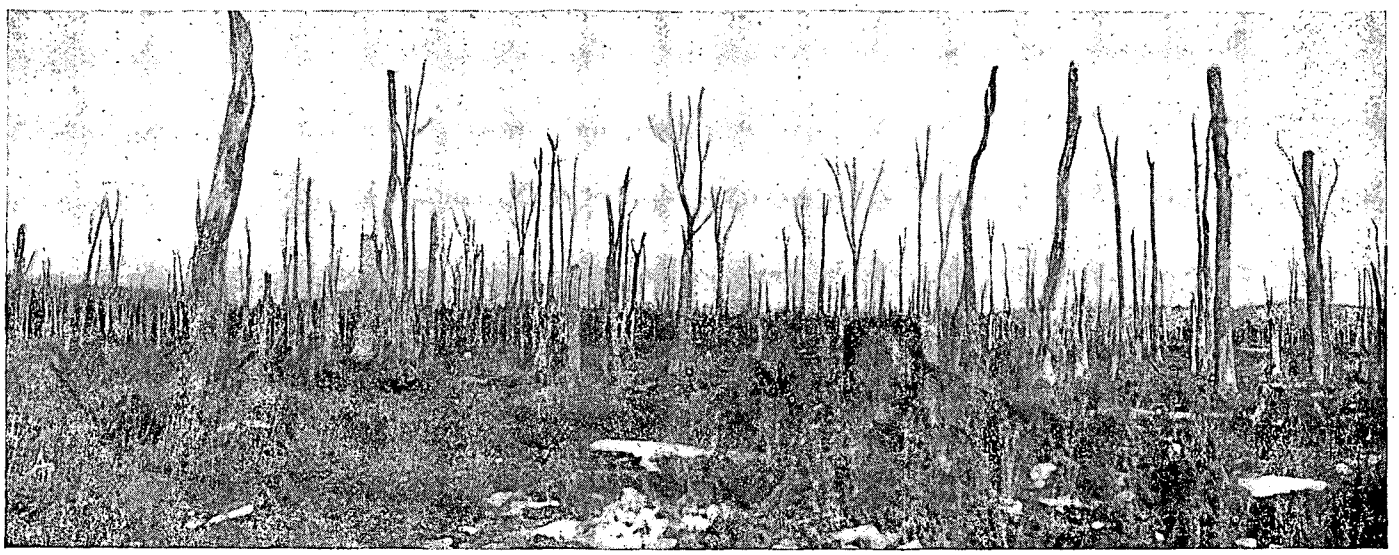

Fire usually follows the axe: a waste with no cover forestation is the result

bit, and at a very high cost on account of its long distance from market.

In the state of Washington, a middle western lumber company is building two of the largest mills in the world with a capacity of one million feet of lumber per day. The company controls one and one-half million acres of land and at the rate of cutting—as planned—will denude their acreage in fifteen years. These trees—the Douglas fir—are a natural regrowth; it took fifty years or more to grow the forests that are now being cut.

BUT it is not alone the demands of our industries that have depleted our timber lands. They at least have used what they have taken. Perhaps the greatest devastators of our forests are fire and unscientific cutting. One-tenth of the destruction of our forests is due to fire, while nine-tenths is due to cutting with practically no regrowth.

Concerted action must be taken to stop forest devastation, and to encourage reforestation. It requires fifty years for a tree to grow the proper size for saw lumber and less than that for pulp, and were we replanting a tree for everyone cut, there would be no difficulty.

But in the United States four and one-half times more lumber is being cut each year than is being grown!

Enough stress cannot be placed upon the need for adequate measures to prevent forest fires. Many states have organized efficient fire fighting methods. New York has placed on sixty-five of the highest peaks in the Adirondacks and Catskills steel observation towers. These towers are manned by competent observers during the dry seasons and are connected by telephone with the houses of the forest rangers. When a fire occurs the observer telephones the ranger who com-

A mountain side once covered with trees, but the destruction by cutting, followed by fire, has left a waste where there is no forest cover left. The result is a quick run-off of water

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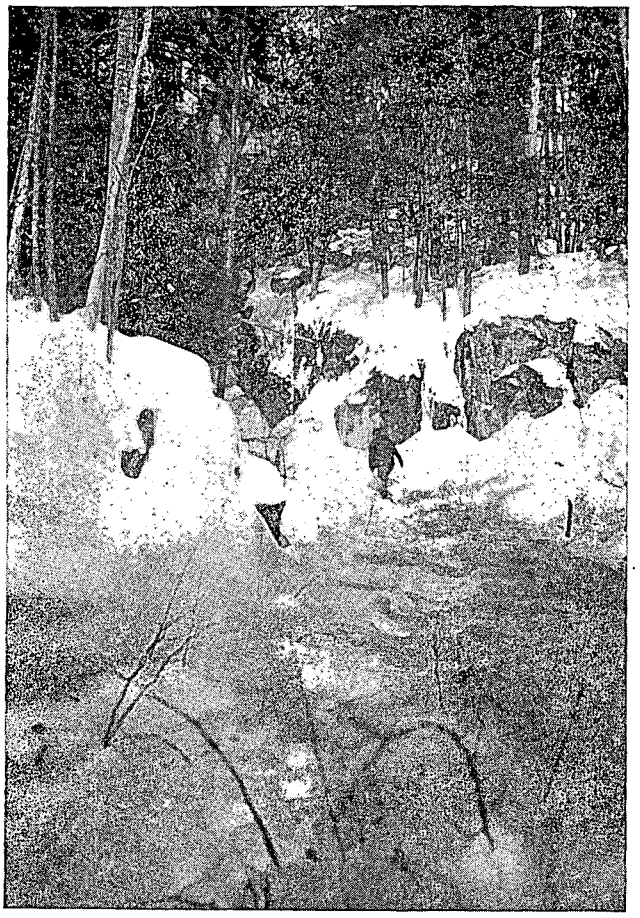
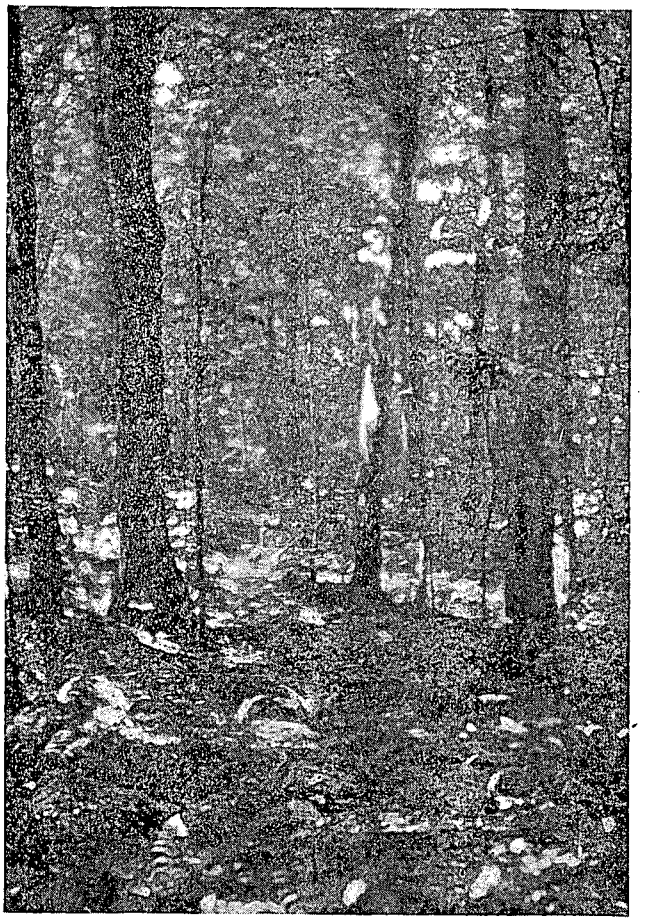


The snows of winter melt slowly in forested areas and the water is held in check by the spongy bed



In summer the forests hold the water in check by the protection given by the shade of the trees

mandeers the men of the neighborhood. No time can be lost, as the conflagration must be checked before it gains headway. The expense of the operation is an economy, for thousands and even hundreds of thousands of dollars are saved each year. This past summer a forest fire occurred in New Brunswick, Canada, with an estimated loss of $200,000. An expenditure of less than $5,000 in the method indicated could probably have prevented this fire.

In Canadian forests, where large areas have to be covered, aeroplanes have been used successfully in discovering fires, but the fire tower is far more practical in a section where areas are high and not extending over too large a stretch of uninhabited country.

The time has come for greater cooperation between the Federal government and the individual states in all phases of forest protection. To this end, a senate committee has this last year visited the different states endeavoring to ascertain what their needs are and how much they have cooperated in fire fighting, tree planting, forest research and the like. This investigation was preliminary to the introduction by Senator McNary and Representative Clark at the present session of Congress of a bill, under which the Government will make certain appropriations to the states. Under this bill but $100,000 is allowed for tree planting, with the further proviso "that the amount expended by the federal government in cooperation with any state during any fiscal year for such purpose shall not exceed the amount expended by the state for the same purpose during the fiscal year." Some of the southern states are poor and cannot afford large appropriations for tree planting, but the necessity for reforestation is urgent. About $2,500,000 under this bill is set aside for cooperation with the states in fighting forest fires and for other purposes: and there is an item of $100,000 for educational work with farmers and other owners of woodlands.

To the mind of the writer the amount proposed in this and other bills is far too small, especially in the matter of acquiring land for public forests. Colonel Henry S. Graves, head of the Yale School of Forestry and former chief forester of the federal government, says in an article in American Forests and Forest Life:

> Congress is now making appropriations for buying forest lands at the rate of less than one-half million dollars a year—a sum utterly inadequate to our needs. We do not realize that the United States is making an investment in the acquisition of forest lands which will yield tremendous returns and which will soon be on a self supporting basis. And while Congress is scrutinizing these small items with the utmost economy, it is making large appropriations to meet other national needs of less immediate urgency to the permanent welfare of the nation. A sum equivalent to the cost of two modern battleships, if appropriated to national forestry *now*, would prevent an impending economic disaster. . . .
>
> We delay. We put off attacking the problem while our forest capital grows smaller and smaller. We court the day when our need for wood becomes so dire that public opinion will demand a national expenditure of one or two hundred million dollars a year. It is obvious that, under the pressure of an immediate emergency, such a sum cannot be economically spent, and that industrial and economic distress cannot be ameliorated. However much we spend, we must wait for the timber to grow. Future wood requirements of the nation must be provided for in advance. There is no other way.
>
> One hundred million dollars now, advanced over a reasonable period of years, made available as the fiscal conditions of the country permit, will do what one billion dollars cannot do when the emergency is upon us twenty or thirty years hence.

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The public should own half of the timber-growing land in the United States, and this land should be well distributed through all the principal forest regions. The states and municipalities should be given every encouragement to acquire forest land, but the Federal Government must take the lead. In all federal acquisitions, there must be an equitable compensation to communities for the tax returns of which they are deprived.

"BUT," someone may ask, "why all this worry about wood and forests? Have we not substitutes for wood and are its uses not growing less?" To those who thus think of our forests simply as the source of our wood supply, I would point to the terrific floods occurring every year in states where the forest lands have been denuded. The forests act as a sponge or reservoir, holding the melting snows in spring and the heavy rains of summer, so that the water is fed gradually to the springs and streams. The floor of the forest is made up of leaves and moss making a soft absorbent mass which retains the moisture as it falls. Even during a dry summer the springs, in well-forested areas, run during the entire season. Destroy this forest condition and a change of action immediately takes place. The warm suns of spring meet the snows, the water rushes away with nothing to check it.

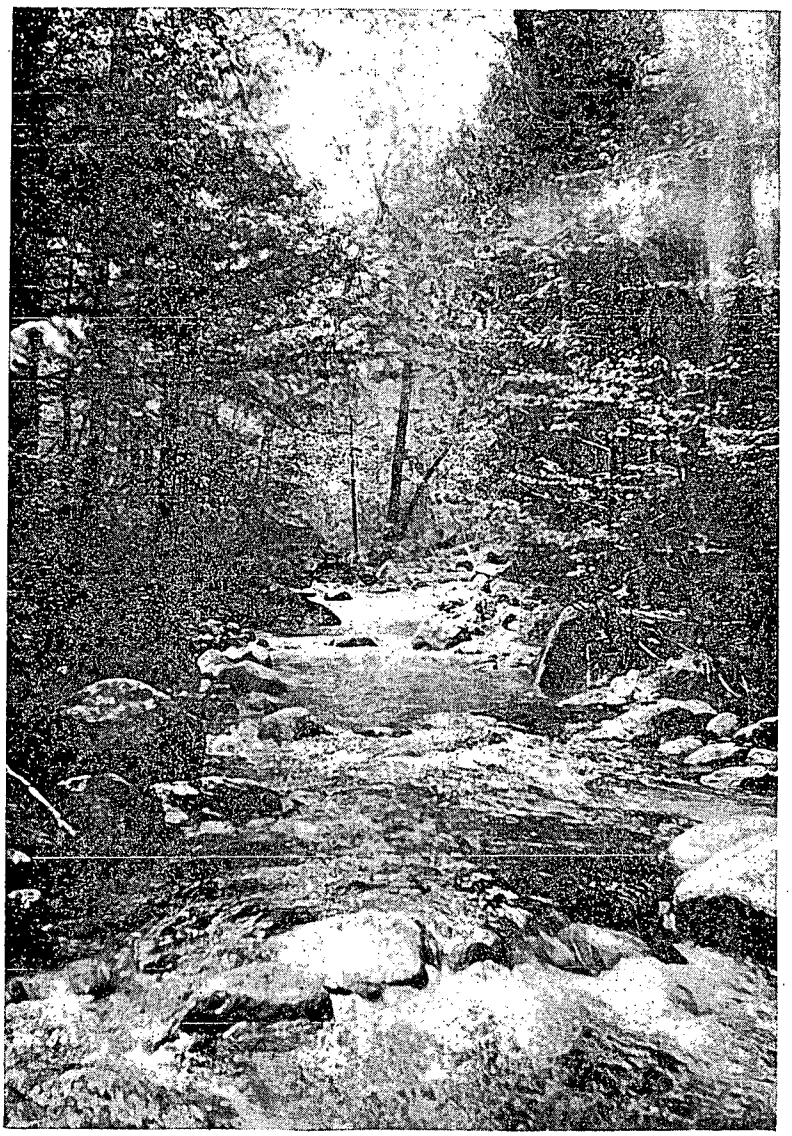
Cloudbursts in summer or fall bring about a like condition; without the restraining forests, the rivers are swelled to overflowing, property is destroyed and life is endangered. From 1900 to 1908, property to the value of $850,186,720 was damaged due to stream overflow according to the estimates of men competent to judge.

So that side by side with the wanton wastefulness of our wood supply, we have wasted our water supply. Our coal has been growing gradually less, with no recurring crop. Our waters with their power potentialities, now known as "white coal," must be conserved and wisely developed to take the place of disappearing coal supplies. A ton of coal, once used, is gone forever; with water the energy alone is used and the flow of water is of value again and again.

A comparison of water power which has been developed and the potential water power resources of the United States is significant. There is a total of 3,120 hydro-electric plants of all types, public utility, municipal, manufacturing, etc., with a capacity of 7,926,958 hp. against a possible minimum water power development of 27,943,000 hp. and a maximum of 53,906,000 hp. This maximum potential water power will be materially increased by the proper protection of the forested areas.

DRIVES have constantly been made by the power owners to invade the sanctity of our national and state parks, but to date their efforts have been in vain. May they ever be prevented from encroaching upon these areas set aside for the enjoyment of the public!

It has taken our citizens years to awaken to the fact that they can secure recreation of their tired bodies by going to the forests and woods where they can commune with God and nature. But added numbers are doing it constantly, aided by the motor which makes distances short and camping equipment which cuts the costs of outings to the woods. A better class of citizens, more self reliant, more vigorous and better fitted to cope with the everyday problems of life, will result from frequent contact with the great out-of-doors.



The tree-shaded streams are potential sources of hydraulic power

We need the woods for them too.

A view back to what we have had and a look forward to what we will have—or will *not* have—unless we mend our ways, is what every thoughtful citizen should take. With the opportunity still open—before it is too late—let each one of us take the responsibility on ourselves to urge upon our representatives in Washington the early enactment of the necessary legislation, to bring about, as Col. Graves has said in his article quoted above, an appropriation of $100,000,000 to be expended over a period of years:

First, for the acquisition of large areas of denuded forest lands on which the Government can plant and control trees, thus also protecting our water supply.

Second, for assistance to the several states in preventing fires, planting trees and fighting tree pests.

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Power and Culture

By JOSEPH K. HART

"We stand today where the Greeks once stood: face to face with fate. We have Power beyond their dreams of power: power that indisputably belongs in the realm of nature, the proper use of which need not degrade a single human being. We can see the Fates at work. Upon the foundations of great but decentralized power we can build small communities where life and culture can be rooted in normal relationships . . . . We can lay hold of the materials of the future and organize them into a world in which humanity will be free and enfranchised; or a world in which humanity will be buried under the mazes of economic mechanisms."

MAN is dependent upon nature: "The earth is the mother of all mankind." For food, shelter, clothing, for the materials that help to adorn and beautify, man must go to nature. Though he may not live by bread alone, he cannot live without bread. One need not be an irrational materialist, enamoured of the economic interpretation of history, to admit these facts!

On the other hand, man's most strenuous efforts have been given to the attempt to escape from nature. Nature, primitive and undisciplined, provides precariously for man, keeping him near the margin of subsistence. Below certain levels the earth is a fairly wise mother; above those levels she is stupid and jealous, degrading her children, telling them tales of danger, filling their minds with fear. One need not be an incurable idealist to acknowledge these facts!

An animal, having gathered a few sticks, leaves or straws, for a nest or a lair, is at home with nature, accepting life or death unquestioningly. But man has long been at war with his mother. As an obedient son, using nothing but his bare hands, he was bound to remain a brother of the beasts. Early in childhood, however, he learned a few secrets, such as the use of fire and how to make some simple tools. These gave him the taste of power and a dawning sense of independence. But shortly the jealousy of his mother appeared; she seemed not a true mother, but only step-mother: his hope of happiness lay in outwitting her completely, learning how to control her and make her work for him, thus assuring his escape. Little by little, the meaning of this project has emerged: he must make nature over, on lines nearer to his needs; he must turn nature into a great machine, subject to his control, serving his every desire.

This was an adventure so presumptious and so perilous that most subsequent ages have called it irreverent, profane. Some have even spoken of it as the "Fall of Man."

His method, slowly evolved, has been "Divide and conquer!" Mastering some bit of nature, he has turned its forces against the rest. The winds have blown his boats to windward. The waters have run up hill. He has poured iron out like water. He has turned night into day. In short, he has decreed his own freedom, and attempted to enter the decree upon the records of time.

Slowly, in the course of his struggles, man has found certain clues to his problem. Otis T. Mason, the American anthropologist, enumerates the five factors with which men must reckon:

Raw materials, of almost endless variety and usefulness;
Motive powers, from simple muscular energy to the most complex forms of force;
Tools and machinery, in ever-changing types;
Processes of fabrication, simple, complex and compound;
Products, the things sought for, with which man nourishes and supports his life.

At first these products were purely physical: they nourished and supported man's physical life. But in fabrication there was a factor not fully comprehended within the physical; in products there were elements not wholly to be classed as useful; and in man, himself, there was something not dreamed of in the philosophy of nature. Give them time: these are the most important elements in the scene.

Now, in this long struggle, two irritating implications have ever been latent. First, not more has man reshaped nature than nature has reshaped man. Challenging nature, he overcame her in part, and won a momentary control, with freedom. He used that freedom to consolidate his gains and to organize himself into this re-made world. Naively, he assumed that, though he was thus at home in a changed world, he had remained unchanged. He even argued that, however much nature may be made over, "human nature never changes." But the plea is not convincing. The earth has been cultivated in part, and man has become cultured in part. History is the story of the stages through which man and nature have made each other over almost beyond recognition. Man's refusal to admit change is responsible for some great difficulties.

The second of these irritations is a question: Which is to be master, at last, Man or Nature, mind or the machine? History has given various replies to this question. When machines were small and unimposing, men were not greatly cowed by them. But as machines have grown in size and complexity, man has been more and more impressed; until, now, we are not far from worshipping the machine. Our sciences translate us into the likeness of machines. That fact is interesting. If the machine shall reduce us to subjection, Mother Earth will have her revenge: the machine is nature dressed up in modern clothes!

The extent of man's escape from nature may be roughly measured by the surplus he is able to accumulate—the margin of his supplies, actual and potential, above his needs. Surplus is largely a function of the organization of the five factors enumerated above. "Man came to the threshold of civilization," says Morgan, in his Ancient Society, "when he brought about the union of the animal, vegetable and mineral worlds—that is, when he harnessed the ox to an iron plow for the purpose of cultivating the cereals." That organization of power, tools and processes assured a surplus. That surplus enabled man, at least some men, to be free, at least a part of the time. Freedom meant leisure: leisure

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might mean the discovery of unsuspected values in the world and in human living.

The fundamental factor is power. Materials are everywhere. Tools and fabricating processes and, hence, products will follow upon the coming of power. But power is elusive. Wind and water are fickle, undependable. The strength of animals is dependable; but it is slight, and it requires too much oversight. Power must be plentiful, dependable and requires small oversight. Such power was first found in Slavery.

"Mastering some bit of nature, man has turned its forces against the rest. The winds have blown his boats to windward. The waters have run up hill. He has poured iron out like water. He has turned night into day. In short, he has decreed his own freedom, and attempted to enter the decree upon the records of time!"

The slave is the most intelligent application of power to work that has ever been known: he *is* power—intelligent, automotive power. The slave is not efficient; hence, his numbers must be great. But being intelligent, he not only performs work, he can plan and oversee it. Thus, he releases free men completely from nature, providing time for the development of the arts and cultures of life.

THESE conditions were fulfilled in preëminent measure in Athens, "that point of light in history." A sufficient supply of slave-power freed the citizen from all the stresses of physical existence into a congenial leisure. Freedom revealed the social and moral chaos of the times: barbarian hordes were pressing in to destroy; within himself were areas of impulse, rages and passions that might easily betray him. Having risen above physical nature, he must overcome the barbarian, without and within, and make a world fit for Man.

Led by artists, philosophers and scientists, and by statesmen who, for a time, at least, believed that these have a valid function in society, the Greeks rose above their ancient rages and fears and achieved an ideal world, of serene great beauty, wherein one might meet Fate calmly as became a Man. They became human. They discovered humanity. And they bequeathed it, as a precious treasure, to the ages.

Greek culture was a community enterprise. Slavery made it possible. All the arts and sciences contributed to it. It exalted excellence. Men created beautiful objects, wrote beautiful poetry, trained their bodies to the highest pitch of strength and agility and displayed their prowess in civic contests. They gave to the world a revelation that still haunts the mind. We know, when we are most aware, that any conception of living that neglects beauty is an unworthy, if not a degraded conception.

But there was a defect in Greek life which was inevitably reflected in Greek culture. The community was but partially human: nine-tenths of it was slave. The slave who made Greek culture possible had no share in that culture. Individualists and abstract "humanists" may argue that culture should be above the battle of the classes. The argument gains no support from Athens. Greek culture, compelled to ignore and deny nine-tenths of the people, became remote from life, as it was remote from work; it became intellectual, non-social, fragmentary. A fragment of humanity, however free, can never create more than a fragmentary "humanism." Power, even slave power, laughs at man when he presumes too far upon freedom!

To be sure, the Greeks sought to overcome this defect by a *tour de force*: they ruled the slave outside the limits of the "human." Man in his struggle for control had set himself over against nature. Power is of nature. The slave was a form of power; hence, he belonged to nature, not to humanity. Greek culture was for free men, not for slaves. It was liberal, not servile; for the man of leisure, not for the worker.

If such a distinction had held, Greek culture would have been inclusive of "the humanities." But the Greeks never fully accepted it; and the modern world has denied it. Modern "humanists" have, however, sat at the feet of the Greeks for two thousand years, giving them the homage of sincerest imitation. But the verdict of the modern world seems to be that a "humanity" that could consign a major part of the race outside the bounds of the "human" could, at the best, produce an imperfect, not a true "humanism."

The glory that was Greece failed. Culture is not a veneer upon life: it is of the substance of life. In order to establish an ideal, the Greeks became intellectually dishonest: they degraded some part of their humanity, identified it with nature, and called it "power." Thus they justified their free life. We have the fragments of their culture—nothing else—today.

WE pause in the flight of the centuries only long enough to recall that the culture of the Middle Ages was builded upon a quibble. The labor power of the age was the feudal serf. The serf was neither bound nor free, neither wholly of nature nor fully human. He was by way of escaping from nature into humanity. He had some share in religion, though not in the civic life. Work was the most effective humanizer. In the later centuries freedom could be achieved by escaping from the land to the cities. The culture of the Middle Ages was largely the work of escaped serfs, who in the cities achieved their moral and artistic enfranchisement as well as their civil liberty. By the thirteenth century, the towns and cities were filled with these freed workers and their guilds, both of the artists and the artisans, were flourishing. Thought of this age centers mostly about the great cathedrals. But beyond those monuments lie centuries of struggle for freedom and control; and all about them are the only slightly less remarkable achievements in every line of artistry. From the thirteenth to the eighteenth century, free workers, whether artist or artisan, were building up standards of integrity in workmanship. Some, still struggling with the past, "wrought in a sad sincerity"; others, feeling the freedom of the future, wrought in a joy hitherto unknown. But each

. . . . "builded better than he knew,—
The conscious stone to beauty grew!"

And we pay our tribute by prizing their works as "antiques".

Into this world of handcraftsmanship, so human, so artistic, so inefficient, came the Steam Engine, discovering unsuspected reservoirs of power. This power has changed the face of the world—not alone the world of work, but of all other ranges of human living. These changes constitute the so-called "Industrial Revolution." What have been the characteristics of this age of change?

1. Steam made all other forms of power, wind, water, the slave and the serf, subordinate, and promised quickly to make

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them obsolete. That is to say, steam organized about itself the industries of the world.

2. Steam tore people loose from their local communities and began to crowd them into narrow areas around new centers of industry. It has successively torn people of all stages of culture loose from their old rootages in local groups and gathered them into polygot centers of industry and commerce. Steam has been, and is, the great centralizer.

3. Steam has supplied the world with unlimited products for nourishing and adorning life: an incredible range of useful and useless implements, weapons, tools, gewgaws, impedimenta; machines of transportation; and, by means of a variation, the gas engine, with the automobile and the flying machine. These, by their very nature the tools and the *means* of life, have charmed and bewildered us until we have transformed them into the *meanings* and the *ends* of life.

"If the machine shall reduce us to subjection, Mother Earth will have her revenge: the machine is nature dressed up in modern clothes!"

"Where shall we find that 'silence and slow time' of which, according to Keats, culture is the foster child?"

4. Hence, steam has torn us free from old standards of workmanship, taste and culture. By giving us cheap, machine-made articles in unlimited quantities in place of the older hand-made objects, steam has made the world more comfortable: but at the price of substituting display and exaggeration for use and beauty. Inevitably, the nineteenth century was an epoch of vulgar comfort.

Within a century, at least half the people of the world felt these effects in some degree. In the western world, at least one-third of the population has been torn loose from former contacts with nature and crowded into the industrial cities, there to live an alien and artificial sort of life. The industrial city rests upon the steam engine. "Large-scale organization," of industry and of living has been the key-note of the industrial revolution.

BUT man's inner life is responsive to his environment. This is "adaptation." Now, since environment in the modern city is almost completely artificial, man has necessarily become artificial, also. His culture has become artificial. He has made himself too free from nature. He has shut out the stars with his roofs and his smoke. He no longer hears the breaking of waves over deep seas; no longer fights with the wilderness far on the frontiers; no longer follows the aurora over the silent snow-fields. He has ceased to renew his spiritual life at the ancient springs. Books tell of men and women who once did those things; but the books are scarcely credible. Men go, it is true, at times, to the mountains or the sea, for the purpose of escaping from spiritual dyspepsia—in order that they may, once more, enjoy the feast the city offers. And what is that feast?

Bacon has told us how the scholastics, turning ever inward for the materials of their dialectic, were like spiders that spin endless threads of disputation out of their own bodies. We have been moving in similar directions. When the mind of man loses contact with nature, it turns in upon itself, and spins out of its own memories, endless repetitions, endless monotonies. Its art becomes superficial and clever: endless variations upon the same literary theme; machine-made music; pictures by wholesale. Lacking ideas, it writes poems with the supreme distinction that each line begins with a small letter.

Even so, men cannot live in this way forever. Bored by it, but having no other escape, they revert to primitive nature, to as much of reality as remains to them: to undisciplined instinct; to movies that show "he-men"; to jazz and dances that exaggerate sex-motives; to novels that reek with decadent sex-recitals; to pugilistic encounters that smell of blood; to court trials that display sadistic experiences; to theatricals that "exalt the human form."

Meanwhile governmental and industrial leaders, protecting their own freedom, after a fashion, by trips to Palm Beach or to Europe, talk glibly of the "advantages of the machine era." It has given us, they say, comforts beyond the dreams of avarice in other eras: health, prosperity, long life; a standard elementary education for all; unimpeachable patriotism; seats in the park; and athletic contests more thrilling than any since the days of the circus in Rome. And our culture leaders, admitting as glibly that there can be no hope of an indigenous culture in our machine civilization, happily tell us that what we need, and "all that we need" is an importation of the "humanities" of the Greeks. "We have utility; the Greeks had 'humanity': add them together and secure the finest civilization possible to men!"

BUT some are not wholly convinced by these reputed virtues of the machine age: freedom by proxy and culture by addition. The sense of loss is too great:

We have lost contact with nature—the contact that gave to man his first challenges, his first joy of battle, his first sense of victory.

We have lost that neighborliness which was characteristic of the older community, when men lived in homes and worked with their hands. The steam engine first undermined that community, and the automobile has completed its destruction.

We have lost practically all of the integrity of our old craftsmanship. The machine is not interested in integrity: only in form. Both the artist and the artisan have suffered spiritual dislocation. The artisan now works, dispiritedly, for the machine; and the artist, competing with the machine, too often sells his soul to feed his body.

We have lost practically all control of our destinies. We work when the machine works; we do what the machine commands; we use the products the machine turns out. We are educated to work with the machine and to use machine-made products.

In the centuries of free workmanship, especially in pioneer America, men were moving slowly toward a finer humanity, a real community, in which every individual might find himself at home. They dreamed of liberty and fraternity. Perhaps it was a fool's dream! At any rate, the steam engine, in building our industrial cities, has cut us, more or less sharply, into two groups once more: the owners and the workers. The owners, as free and independent centers of control, make up humanity; the workers, as attachments to the machine, are not sure where they belong!

They are not slaves, bound to the wheel of labor: they can always give up their jobs—at least one at a time. In religion and politics they boast equality with the owners. They are schooled at the expense of the community. But in economics they are still classed as "labor power," and they are dealt with as if they were something that humanity must control in order to maintain its own precariously achieved freedom.

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Since about 1890, electricity has been more and more applied, subordinately, to the steam-driven machine, making that machine more completely automatic. (Electricity has not been, at least until quite recently, a power in its own right; it has been a helper of other power.) Working with automatic machines, the worker has grown more automatic: an "iron man," a "robot." His task can be learned in a few hours, or days, at most; and once learned, it can be changed only with the greatest difficulty. "It never was so easy before for a simpleton to live!" Nature has had her revenge: man's long struggle with her has come to this, that for the masses of men, while their physical lives are far more comfortable, less precarious, than was the case with primitive men, their mental and cultural lives are more completely submerged in "things" than has been the case since the first few awkward upward steps were taken in the primitive wilderness.

The culture of the Greeks grew, as we have seen, out of a great stress: the struggle of noble spirits against the over-powering Fates; the struggle for Order in the midst of an all-devouring chaos, for a Mind that should rise above non-mind and find or give a meaning to existence. They failed; but that was what they sought!

Today we have reached the sublime belief that the Machine is the nearest approach to Reason and Mind that we shall ever reach: the Machine stands between us and every sort of chaos: it feeds us, clothes us and educates us; it fights our battles for us and organizes our peace. The Machine is the last word in cosmic progress. We have susbstituted it for the spirit that once was in us; we have made ourselves over, in our psychologies, on the model of the Machine: we have lost our souls for it; some say we have even lost our minds! Is there no escape for the race from these untoward, tragic happenings?

The industrial city is too unhuman to be the home of the human spirit. If, for Plato, Athens was too large, what shall be said of our modern aggregates of shifting, drifting men? It is true that the great city has become the center of the greatest stimulations the world has ever known. But these stimulations are practically all upon the periphery of life: they do not reach the center. Such peripheral stimulations make for cleverness and smartness: for the literature of Gertrude Stein, which has no "message," only "suggestions"; for arts whose boast is that they have no meaning.

But what shall the soul do that cannot nourish itself on words; that longs to find the ancient springs where it may drink long at the fountain of living waters? Where shall it find that "silence and slow time," of which, according to Keats, culture is the foster-child? Are all such questions infantile survivals which the "manhood of humanity" should have long escaped? Should things have no meaning? If things should come to have meaning would that fact challenge the dominance of the Machine in human living?

The question has been raised. Men are in revolt against an industry in subordination to which, they "dig the ditch, in order to get money, with which to buy food, so that they can have enough strength to dig the ditch!" The Machine has taken on the form of Fate, remorseless Fate. Two things men want today—to wit: contact with the earth once more, and more neighborly contacts with their human kind! And these two desires seem not so unattainable today as they seemed five years ago!

CENTRALIZATION has claimed everything for a century: the results are apparent on every hand. But the reign of steam approaches its end: a new stage in the industrial revolution comes on. Electric power, breaking away from its servitude to steam, is becoming independent. Electricity is a decentralizing form of power: it runs out over distributing lines and subdivides to all the minutiae of life and need. Working with it, men may feel the thrill of control and freedom once again.

"The future lies open before man, as it did in the day when Joshua said to Israel: "Behold, I have set before you life and good, death and evil: choose ye this day which ye will serve!"

Life need no longer be subordinated to steam: Industry can be decentralized—the smaller community can be regained, with its old humanities. The mechanisms of such decentralization now wait man's use: has he the courage to make the world he needs? He could not control the past, for he could not foresee its direction. But now the future lies open before man, as it did in the day when Joshua said to Israel: "Behold, I have set before you life and good, death and evil: choose ye this day which ye will serve!"

Humanity has no spiritual future save in the fight for that economic and social freedom within which the mind can be free. Giant power, under public control, with power distributed to all on equal terms, offers economic freedom to humanity, the hope of communities within which intellectual freedom can be realized and the culture of the spirit will seem possible.

Such decentralization of living will tend to regenerate our culture by releasing it from the city's hot-houses, where it attains a superficial brilliance, and restoring it to its native rootage in reality. In the reinvigorated small community, the free mind will become creative; and schools, within which freer minds may develop, will appear once more.

Holders of vested interests in our present economic order will oppose these developments; and properly so, for salvation must not be too easy. Humanists whose culture is an imitation of the Greeks will also oppose them: a humanism indigenous to our soil would not be to their liking.

For mankind, these are crucial times. Wishing can do little. But thinking can lay hold upon the materials of the future and make a world in which humanity will be freed and enfranchised; or a world in which humanity will lose itself under the mazes of economic mechanisms.

This is the Day of Choosing: We stand, today, where the Greeks once stood: face to face with Fate. We have Power beyond their dreams of power: power that indisputably belongs in the realm of nature, the proper use of which need not degrade a single human being. We can see the Fates at work. We can build communities upon the foundations of great but decentralized power, we can build small communities where life and culture can be rooted in normal relationships. We can provide the materials out of which men can make for themselves the manner of life they prefer. Or, we can surrender to the control of the greater machine, permit electricity to make permanent what the steam-engine began, be happy in the roar of industry and lose all our sense of freedom, justice and beauty. "The history of the world is the world's judgment day!"

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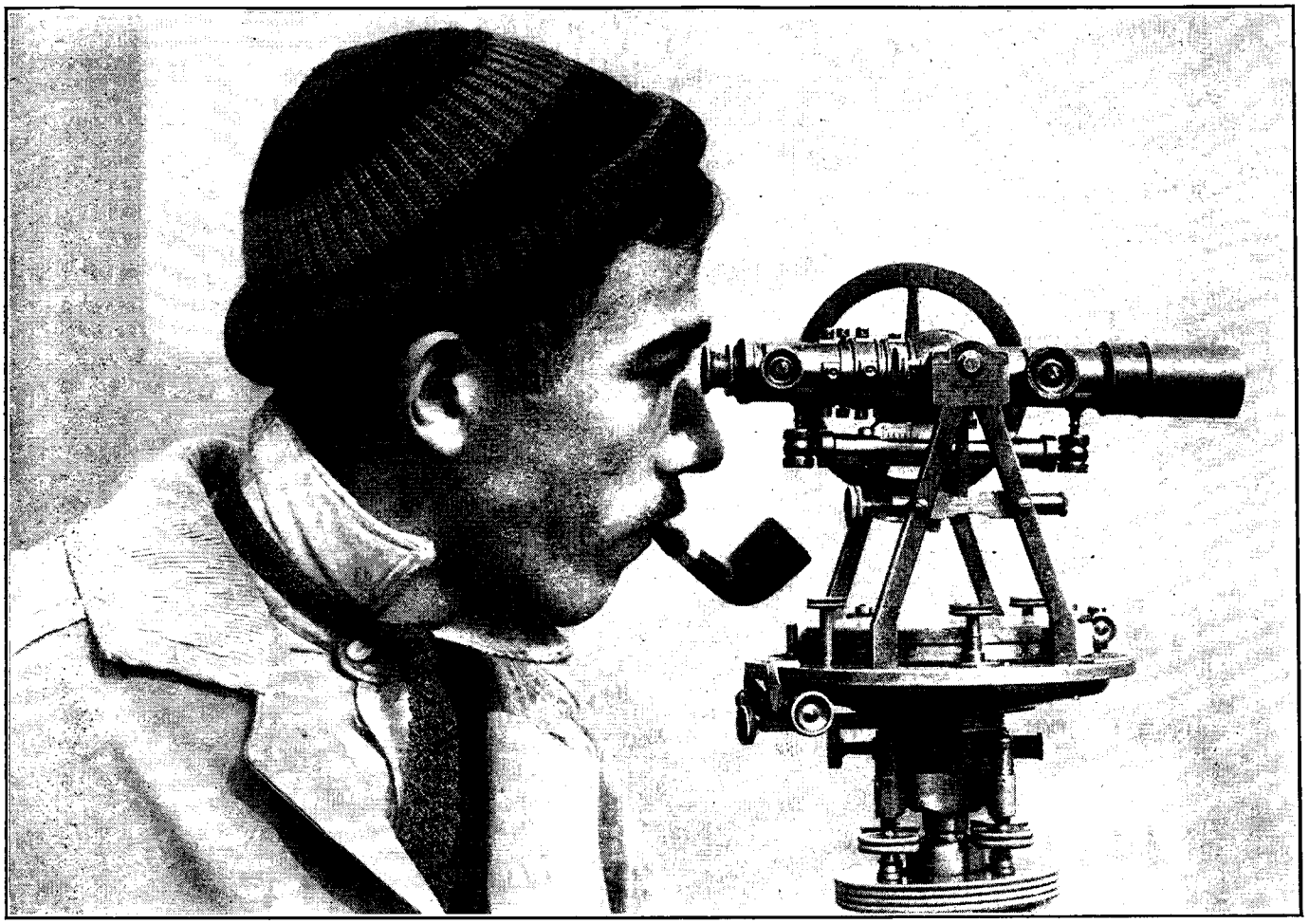

Some Tools of the Trade

Work Portraits by LEWIS W. HINE

THE mind's eye follows the jump from measuring pasture fences to the laying out of a power transmission line across hills and plains and farm lands for five hundred miles.

There has been as tremendous a jump in the matter of the tools with which the engineers have played—from the proverbial transit and sextant of the individual surveyor to the intricate mechanisms of the great hydro-plants and transformer stations.

The modern power house epitomizes the control—or rather the half-mastery—man has gained over the elements. Huge machines work silently in vast structures, with here and there a man or a small group of men. The first impression is that the human factor is negligible.

But one soon realizes the infinite importance of the knots of men who, in whatever capacity, generate these tremendous forces and direct them down controlled channels across the country.

Therein we have the crux of the coming conflicts over the stewardship of electric power, beside which the debates over the railroad question are as a pink tea party and the present agitation over naval oil reserves no more than a tempest in a teapot:

Even an assistant superintendent looks like a pygmy beside the big condenser

The challenge of regions which feel themselves cheated out of their share of energy by the claims of rival industrial districts.

The challenge of consumers who dread the rise of corporate monopolies more autocratic than ever were railroads or banking systems.

The challenge of industrialists fearful lest a handful of men, organized in a union, tie up at their whim the manufacturing of whole regions.

The challenge of the farms to share with the cities.

The challenge of the home to share with the shop.

The challenge of ten thousand claimants for a place in this new sun.

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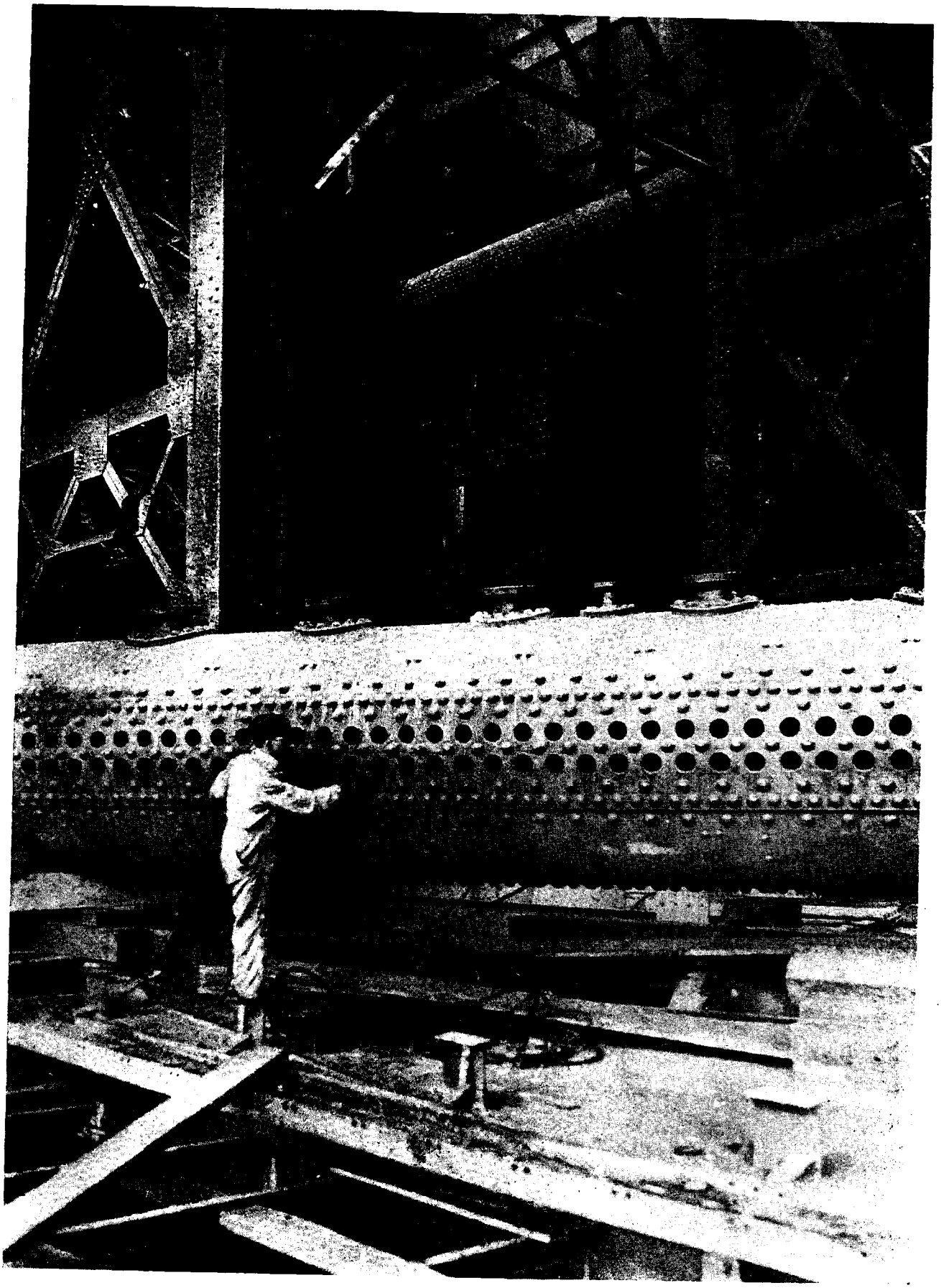

THE BOILER DRUM

One tube in a big fabrication of steel structures invented by man for the production of power

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FEELING ITS PULSE

The big machines almost run themselves until "trouble" begins. Then the electrician functions

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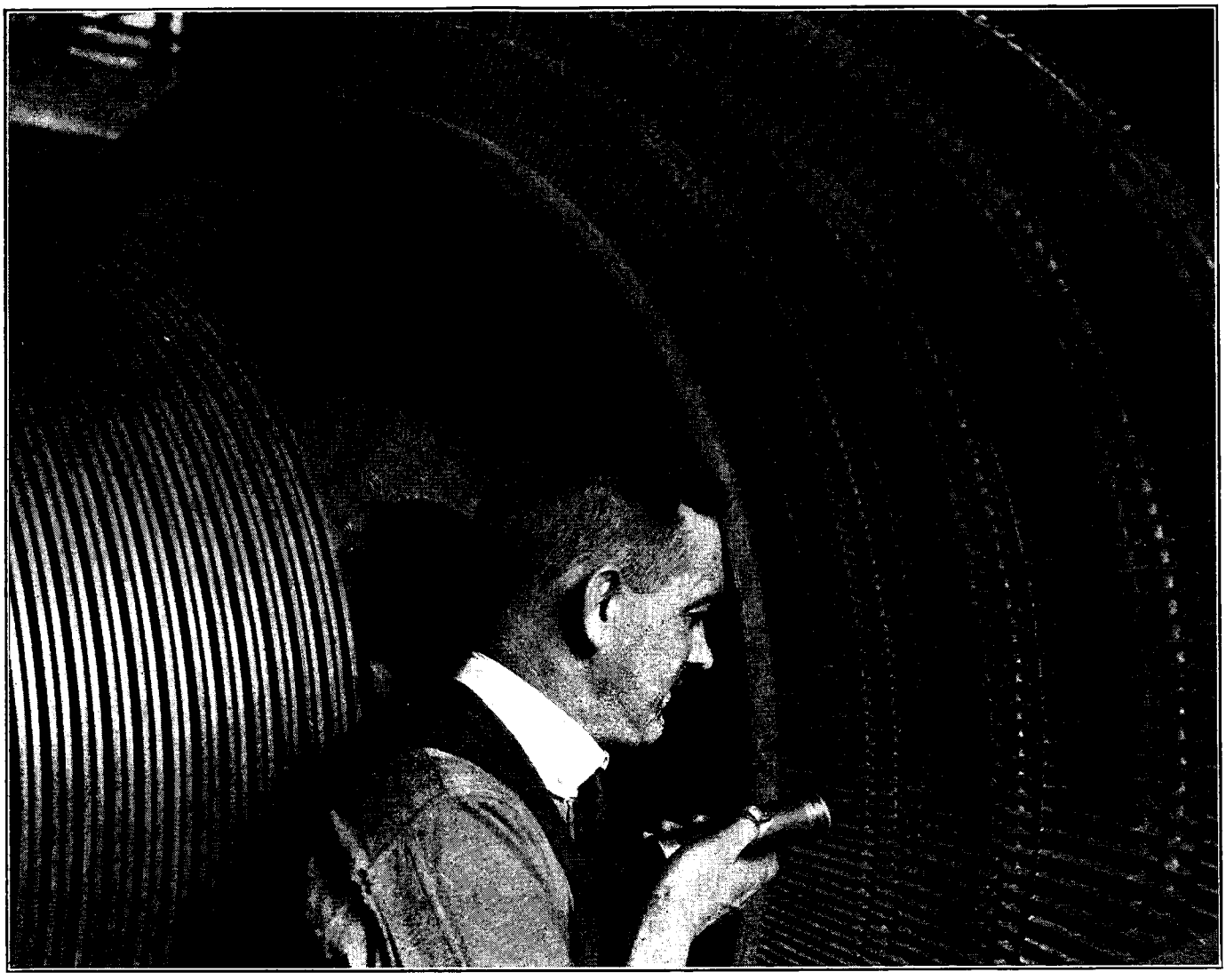
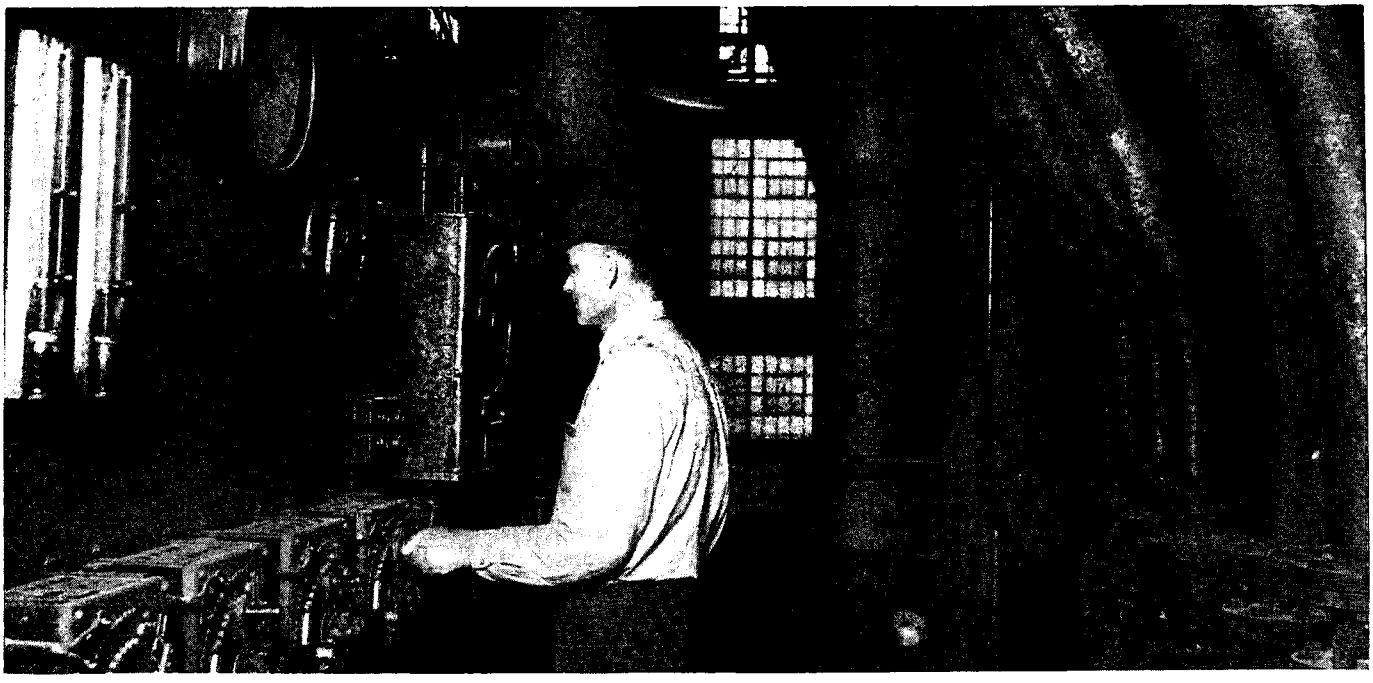


Every inch of the spindle, the heart muscle of the turbine which generates electric power, must pass inspection



Successor to the old time stoker—who shoveled in sweat and grime and strain of back muscles. This boiler operator is making a change in the feed of powdered coal by moving the rheostat on his control board

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Power and Labor

By SAMUEL GOMPERS
President, American Federation of Labor

POWER and its use for peace-time pursuits today engage the attention of the minds which perhaps see farthest into the future. We have, by a more or less haphazard process, built up a miscellaneous and disconnected aggregation of power units; now, by a single sweep these may be connected, related to each other, and with extensions and certain important new developments, be brought into a great national system that will give to the American people a power unexampled anywhere in the world and without precedent even in dreams.

The interest of wage earners in any project calculated to increase the power at the command of the American people is manifest. They cannot escape an interest and an obligation. What we confront is the possibility of doubling our capacity for machine production, through the single agency of power. If we take into account the improvements and inventions in machinery that are sure to come, if we take into account all of the collateral matters, we find ourselves contemplating an age in which our productive capacity may easily enough be well nigh boundless.

We are in the fortunate position of having one great industrial development so shaping itself that we may be in advance cognizant of its coming and in a position to take intelligent action in regard to its development. We, as a people, shall be foolish indeed, if this tremendous development is allowed to roll its great weight upon us without any action on our part looking toward its control and direction. We have before us an opportunity to take one great engine and compel its course so that it shall be to the largest possible extent a well balanced social asset, instead of an engine run primarily for profit and only secondarily for service.

Here is, as if by design, a new engine of production coming into being at a time when the philosophy and the practice of labor is ripe for its coming, ripe for its handling, ripe for its direction, ripe for the bringing of the best results to all of the people.

Already the whole giant power project has become a bone of contention between the advocates of government ownership and those who oppose government ownership.

Yet those who can see the productive possibilities that lie concealed in the great project of power must find themselves inevitably much more concerned about the administration of the creative and productive functions than about the question of ownership of power plants and transmission lines. This is so because power can be made to work wisely and it can be wisely managed and administered, regardless of ownership.

The important thing, then, is that the operation and administration of giant power be placed at the outset on a sound and proper basis, with human service as the great goal; and that is a possibility that can be realized. If we are to be candid about the question of ownership it must be recognized that ownership is already too well developed and fixed to permit of any remarkable changes in that direction within any reasonable period of time. To put it another way, if all effort were to be centered on the issue of ownership—as some would have it—the organization of power, the machinery for its control, administration and use and the fixing of its relation to other factors in production, would be fixed and congealed by the same interests that have always sought to do those things, while the fighting over ownership went on endlessly. It is not wise for those who seek to protect the interests of the people to send all of their forces up one street. The question of ownership is not one to be ignored, but it is not the part of wisdom to regard that question as paramount.

POWER in its relation to life and work is a much more vital thing than machinery in relation to stock certificates and title deeds. There are great questions that press for solution while this dream of ages is in process of materialization at such astounding speed. Paramount among all of these questions is this: Are the wage earners, the men and women who are to operate the machinery of generation and transmission and who are to operate the machinery of use and who, by their very existence give to power so large a portion of its value, to find and hold their proper place in the human organization that is to control the new power in its manufacture, transmission and use?

Financial interests look upon the prospect with a view to new income. Their interest is precisely the same as would be their interest in a fabulously rich gold mine. It is first of all an interest in financial returns; not in production for human use.

Political interests look upon the project as one that may perhaps require new laws and therefore new enforcement agencies, or enlarged enforcement agencies. Inevitably the result in that direction will be an effort to produce fresh inhibitions. Surely human intelligence is capable of something better than the railroad muddle in the development of power. Surely it is capable of something better than the muddling of the mining industry. There has yet grown up no fixed tradition in giant power. There is no dead hand upon the project. There is here the opportunity for control that will function for the good of the industry itself and for the good of industrial life in general. There is every reason why there should be erected for the coming power industry a democratic organization for the operation of that industry.

LABOR advances the following program for application to giant power specifically:

I. It is required that there be a full and frank acknowledgment on the part of the whole industry of the role which labor has to play and of its ability to offer cooperation in practical operation.

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II. With labor's role fully acknowledged, there must then be a consciousness on the part of the whole industry that those who operate the industry in all of its branches are entrusted with vital functions and have obligations to those within the industry, to the natural wealth brought into use and to other industries and the people as a whole.

III. The experience of the industry must determine to a large extent how to organize the factors within the industry on a democratic basis that runs parallel to its functions, so as to discharge these various obligations with justice.

IV. With experience as a guide in the application of the principle, there must come into existence joint representative bodies, in which every useful element within the industry may have a voice and in such manner that it will not be possible for the combined voices of some to smother the voices of others in pursuance of injustice.

V. These joint organizations of representatives must have as their smallest unit the locality, after which larger units may follow in accordance with the natural lines found in the industry itself.

VI. The industry will find itself, as it has indeed already found itself, hampered by restricting laws placed on statute books by political organizations lacking the requisite understanding of industrial needs, or fearful lest an uncurbed industry might become a moloch; and it will be necessary to open the doors by clearing away obstructive legislation. This can not be done unless and until the industry establishes for itself a public confidence, which can be maintained only by full and public industrial accounting. There must be and the people will require a knowledge that the industry knows and practices a moral obligation to the people and that it possesses an intelligence and a method of operation that will promote justice and the highest possible development of its own potentiality.

THERE are the six cardinal points by which the power industry, and every other industry, may emerge from the thrall of political domination and repression, and by which it may emerge from internal strife, uncertainty and blindness.

The sixth point—the winning of freedom from laws that hamper—can not and perhaps should not be achieved until there is an understanding of the five preceding points. Indeed, unless there is an understanding of the five preceding points the people have no recourse except the law, inadequate and idiotic as that generally is.

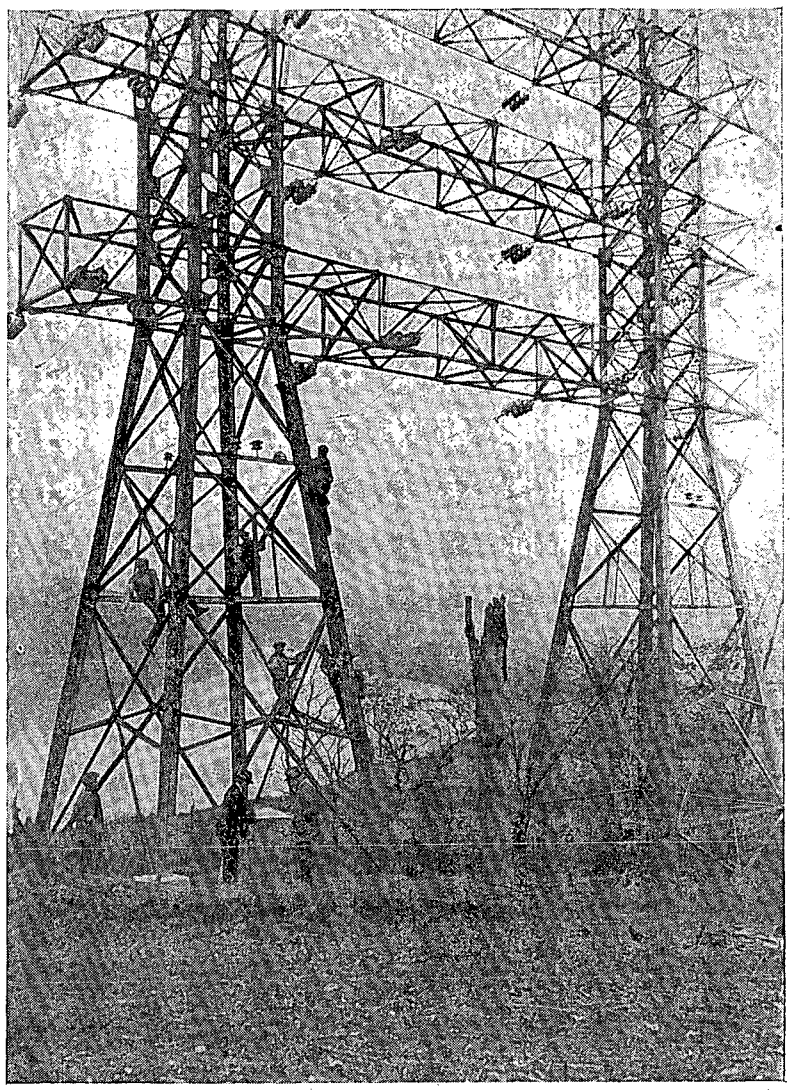
But, if there is a candid agreement upon the first fundamental, the rest follows naturally and rationally. The experience of industry, recorded by each organized group and coordinated in a collective judgment, must determine to a large extent how to organize on a functional basis for creative undertakings. The industry must develop a responsible mastery over itself, and there is no other way. It must bring into its own house an understanding of its true function, a sense of order and an understanding of its high moral obligation to itself and to the whole community.

RESOLUTIONS ADOPTED BY THE FORTY-THIRD ANNUAL CONVENTION OF THE A. F. OF L.

RESOLVED, By the American Federation of Labor, in annual convention assembled at Portland, Oregon, 1923, that we recommend to all citizens in all States a program of State conservation through complete use and development and control of the waters of the State, as submitted by the State to California voters in the Water and Power Act, and for the service of the people at cost, as opposed to corporation development and control of water resources for private profit; and be it further

RESOLVED, That this organization is unanimously opposed to the subsidizing or granting of other Government financial aid to any private corporation or corporations for the purpose of establishing a privately owned and operated power system, or to any encouragement whatever to a privately owned and operated super-power system; and, be it further

RESOLVED, That we individually and collectively urge upon our respective State legislatures and upon the Federal government, and cause to be given the utmost publicity, the necessity for a coordinated public development and control of said water resources for the service of the people at cost, giving due regard to the four-fold duty of water for domestic supply, for irrigation, power production, and navigation, and to the necessity for flood-water storage and control and to the rights of political subdivisions to the measure of local control in these matters; and that we favor and urge the withdrawal and curtailment of special privileges to private interests controlling this natural resource for incomplete and costly development for private profit.



A tower construction gang

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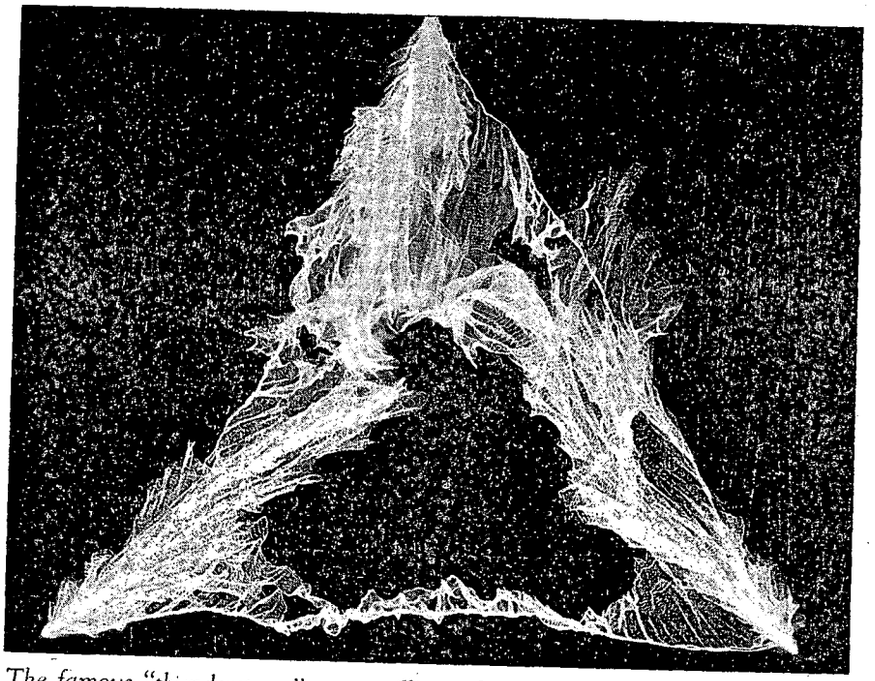

The famous "thunderstorm"—one million volt, nine foot, three-phase arc photographed in the Pittsfield Works of the General Electric Company

The Engineer's Place in Society*

By GERARD SWOPE

UP in the woods and wilds of Canada, a wonderful country of pines and rocks, where I had been camping when it was only a wilderness, was a river with some 600,000 horsepower, constantly going to waste. Through the vision, leadership, courage (and common sense if you will) of an engineer, John E. Aldred, these water powers were harnessed.

Now, let us see what that has done.

That wilderness has been transformed into the habitation of man. Here men have reared their families; schools and churches have been erected, and a community has been founded where before only wild animals roamed. Constructive industries have been placed there, paper and pulp, and metallurgical activities. These industries have not only done things for that particular community, but also are sending their products out into the world and making it possible for human beings to seek and to find more than they ever had before. That is really great constructive work. It has taken vision; it has taken imagination; it has taken great courage; and it has taken common sense in the working out of the details.

Another of these engineering projects, not nearly so large, but no less interesting, is the Roosevelt Dam in Arizona, made possible by the courage and vision of government engineers. That section of the country was all an arid desert on which nothing useful grew. The soil is of volcanic formation. All that it needs for productivity is water.

The rainfall in that region is about eight inches per year, insufficient to irrigate and insufficient to grow anything except cactus and sage brush. So the engineers built a dam 280 feet high, to contain the water gathered from the watershed and the mountains and hills behind it, thus forming a lake some 50 square miles in area in which is collected the rainfall from about five million acres. The dam lets out the water and irrigates about a half million acres. The line of demarcation between the land that is irrigated and the desert land that is not, is as sharply defined as the edge of a table. Where the water has come, vegetation of various sorts, alfalfa and other grasses, thrive and flowers bloom in great profusion and great beauty; on the other side, where the water has not been, the land is as arid as it was for centuries and centuries before.

Into this valley there have moved hundreds and thousands of people, who are now cultivating the soil. They have erected comfortable homes and are rearing their families in comfort.

This water that comes over the dam, as it goes through the waterwheels, produces electricity; so that the dam is not only furnishing the water for irrigation for this region, but is also producing power for its industries (there are copper mines near there) and also power and light for the farms and homes. Thus the people have the comforts that we have in Boston, New York or Chicago, so far as electric lights and other appliances are concerned. The people working on the farms have more industrial appliances than the farmers of New England. It is simply because this cheap power has been created.

The amount of money that these works cost was not very great—some six millions of dollars, I think, which was de-

* The substance of the Aldred lecture delivered at the Massachusetts Institute of Technology.

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frayed by the Government. The people who are using this water now are paying so much per year per acre-foot of water, which is sufficient to pay for the cost of management of the enterprise plus the interest and amortization of the bonds, so that after a certain period the entire bonded indebtedness and the money that the Government has put into the project will be paid back.

But furthermore, the Water Users' Association of that territory has its own management and its own engineers. The Government has put the responsibility into their hands, and they have seen its possibilities, so that now, sixty-five miles below the first location, they are building another dam to accumulate the waters between the first and second dams.

Now, this has done two things. First, it has made a part of the earth's surface habitable which never was habitable before. Second, the products of that territory are now going for the use of mankind in other states, at a lower cost, and a wider distribution than ever before. That, it seems to me, is another type of great constructive enterprise, one that has brought happiness and comfort and a greater amount of well-being, not only to the people who are doing the work but to the people whose needs the enterprise is serving.

IN Portland, Oregon, the country of tremendous logging operations, I went to a paper-and-pulp mill and talked to a man who had spent fifty years in paper-and-pulp mills, first in the East and then going out there as a pioneer in the development of the business. In the last process of paper-making the pulp, held in solution in the water, passes in a thin film between rollers which squeeze the water out, so that finally the paper fibres adhere to one another and form the finished sheet. It is essential that these rollers should run in synchronism, so that no uneven strain is put on these weak fibres as they run through the rollers. This man told me that their machine had formerly been run at about fifty feet a minute, when the superintendent suggested that they run it sixty feet a minute. There was revolution in the shop. It had never been done; they couldn't do it; things would break down; you never could make paper that way! But it *was* done, and done successfully! Today these machines are running a thousand feet a minute with synchronous electric motors. That produces better paper, and twenty times as fast.

By this production, twenty times increased—a thousand feet a minute against fifty—you have cheapened the cost of paper, which has a tremendous significance, especially in a country like our own, whose democracy, if it is to be successful at all, must be founded upon education and the elimination of illiteracy among its people. Therefore, you have made the production of the paper upon which your textbooks and your newspapers and your magazines are dependent, much cheaper, so that they can reach a larger number.

It seems to me that here is the constant test of progress in civilization: does it finally, and in an ever-widening circle, reach a larger and larger number of people in the body politic or in the community of which we are all a part? Progress in civilization means that a larger and larger number of people are constantly participating in its benefit. If they do not, civilization is not making the contribution to human beings that they may rightfully ask of it.

Both engineer and engineering have a very much broader significance than that. Let me speak for a moment of two essentials which underlie engineers and engineering.

First, it is essential that you approach any problem with a careful analysis. What are its elements? You use your mathematical analysis to break down your proposition into its simplest elements and see what those elements are. There is no more exact method than mathematical analysis. It is accurate; you can depend upon it. That is one fine thing in engineering: its basis is a thing you can depend upon.

After you have made your analysis and after you have made up your own mind what is the proper balance of these elements, you must have the courage to make a decision. It is not so much a conscious courage as it is faith that you have made your analysis correctly, that you have placed the proper valuation on the relations of these elements so that you may say, "Yes, that is the result of my analysis and I am going to go ahead."

To my mind there is no better basis for human work than study along engineering lines, if you will give to the engineer also a cultural training, so that he knows something of the history of the development of a people, of its civilization, of its tendencies—so that he can look upon these movements as they arise with some tolerance and also with sympathy. Then it seems to me the engineer will be the best fitted of any to grapple with the problem of life.

AT present there is one problem of our social fabric in which the engineers have done less than other men. I refer to the comparatively new problem of the factory development of industry, where you have, brought together, a large aggregation of capital in the form of a corporation, and large numbers of people employed in the service of that corporation, with consequent questions of management arising. It is not really a question between capital and labor; it is largely a question between management and labor. These corporations have now become so large that almost none are owned or controlled by one or two men. They are usually owned and controlled by thousands and thousands of stockholders in all parts of the country, and often a large part of the stock is held by the workers themselves. The problem is between management and labor, where the manager is as much of an employe as the laborer.

Now the question is how to approach that problem with justice and with sympathy to find the right solution. There

Coming Into His Own

In the solution of the basic human problems arising out of the present day relations between management and labor the engineer has taken little part. This is also true of most of the social problems inherent in our industrial civilization of which the labor problem is typical. The social problems that are arising out of the large scale development of the electrical industry will require for their sound solution a working understanding between the engineer and labor, between the engineer and the social service professions—the doctor, the nurse, the educator, the town and city and regional planner. If the engineer can make contributions that will not only reduce human effort in production so that goods may be made at less cost and so be available to an ever increasing number of people, but can also cooperate with others, whether in the ranks of labor or in the social service professions, who are applying the scientific method to the wider problems of society, he will come into his own.

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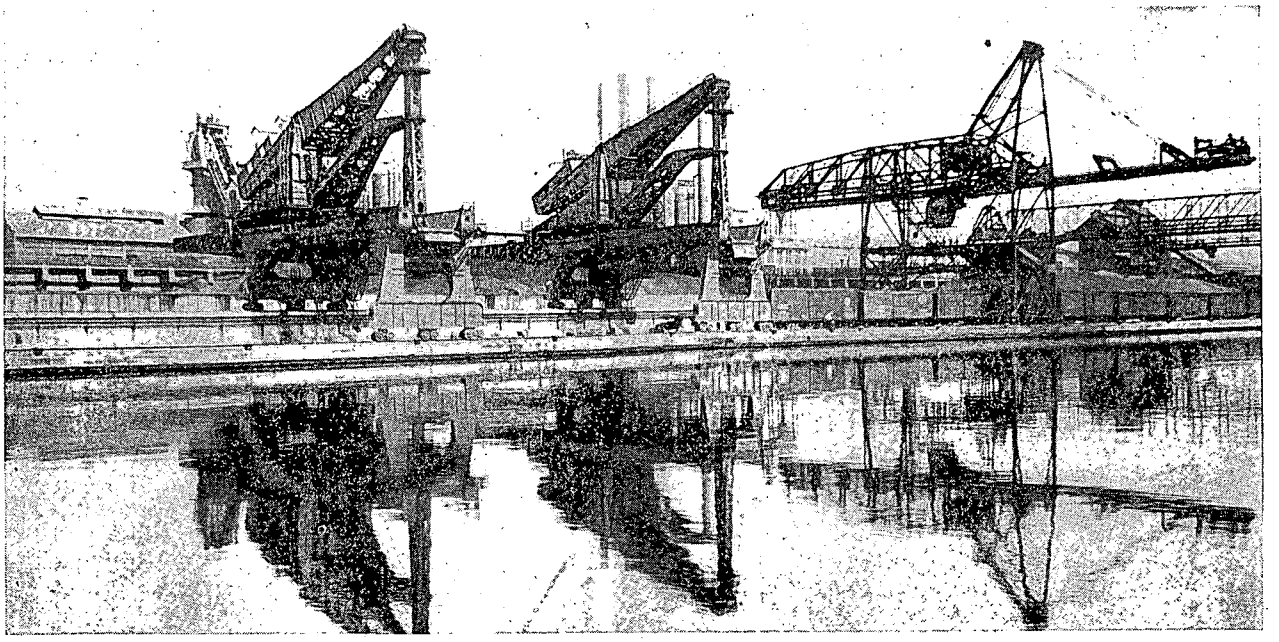

Waterfront of the big Rouge plant—"a great chunk of Pittsburgh transferred to the Detroit suburbs."

The Play of a Big Man with a Little River

An Interview after a Fashion with

HENRY FORD

By PAUL U. KELLOGG

Down Stream on the Rouge

HENRY FORD is doing something on the River Rouge in the way of water power development which is uneconomic as yet; but fascinating. Here he has built four dams, has five in contemplation but, more important, here are the springs of his offer for Muscle Shoals, of his talk of harnessing the Mississippi, of his forecasts of such changes in farming, transit and manufacture as will break up cities, narrow farming down to a twenty-five day year, and make producing villages, with their clustered homes and plants, the foundation stones of a new structure for American life and labor.

ANY one driving along the road can see water power going to waste." Now Henry Ford's feelings about waste are like those of Mr. Podd—or of the Devil for Holy Water. So that is the way he spoke and that no doubt is the way at sixty his mind approaches the subject. "A river that is rolling its way to the sea without working is to Mr. Ford a river in disorder," writes Benson, "and he longs to put it in order by making it work." But the important things in gaging Ford, I take it, are not his rationalizings at sixty but his impulses at ten.

And water power was Ford's first charming encounter in the kingdom of energies which he has helped so mightily to set up as a sort of Fourth Estate to those kingdoms of animals, vegetables and minerals, which he and his playmates learned by rote in the Scotch Settlement School at Dearborn in the sixties.

"One of the first things I was interested in as a boy was water power," he said to me. "I made a little paddle wheel, attached it to a coffee grinder and ground clay. I suppose I was ten or twelve at the time. Yes, I must have been between ten and twelve."

If that be so, this antedated his first anticipations of motor cars, tractors, watches—his first acquaintanceship with springs, steam, electricity, gasoline, coal, alcohol.

"I had a kind of workshop with odds and ends of metal for tools before I had anything else," runs his book in collaboration with Crowther. "My toys were all tools—they still are! And every fragment of machinery was a treasure. The biggest event of those early years was meeting with a road engine about ten miles out of Detroit one day when we were driving to town. I was then twelve years old. The second biggest event was getting a watch—which happened the same year." The road engine was the first vehicle other than horsedrawn he had ever seen and he was off the wagon and talking to the engineer before his father, who was driving, knew what was up. It was that engine, he says, which took him into automotive transportation.

Everybody knows the subsequent story of his motor car and his tractor. Nearly everybody knows of Ford's boyhood exploits as watch tinker to the countryside; though few are aware that he has a bushel or so of watches he has

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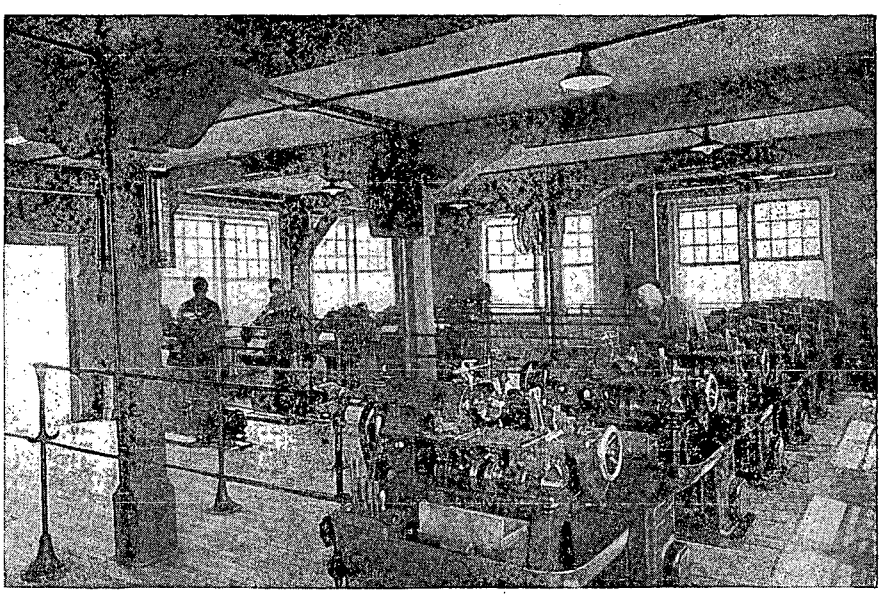
taken apart; or that he has an expert watchmaker inventing with him in his Dearborn workshop today. What he does or does not do with water power is a matter of time which none of those watches has ticked off as yet. It is still pretty much in the future; but it is clearly an interest which has engaged his imagination for half a century.

Marquis, in his book on Ford, speaks of him as a man behind a Chinese wall. Barriers are put up to keep him clear of everything and everybody that would unravel his time—from bishops who want runabouts for their parish workers, to job hunters and cranks. I ran into the wall in common with all interviewers, and it took a week to scale it. In the interval I paddled down stream, as it were, into Mr. Ford's waterpower laboratory. That is, I spent a day with an old schoolmate of mine canoeing on the Kalamazoo River (half way across the state) which we had swum in as boys. We had the stream to ourselves, enfolded in boughs touched with the first frosts, encircling islands, sliding over the riffles which marked gravel bars, and flushing wild duck. The towns that had settled at the fords in the early part of the last century turned their backs on the river with the coming of the railroads. A string of modern paper mills use it as a well, a washtub, a waste-vent; the towns use it as a sewer. But in this stretch at least, its power runs to waste, its beauty goes unnoticed. For Michigan has forgotten her rivers.

The old Nankin flour mill which Ford knew as a boy he has turned into a tiny hydro-plant. Note the heavy hewn beams of the interior in the picture below.

THE River Rouge is such another half-forgotten stream; only smaller; practically unknown to the million people who make up Detroit. Fifty years ago things were different. Fifty years ago, at Northville well up on the Rouge there was a flour mill and another at Waterford. Below came the Phoenix and Plymouth and Beals mills. At Newburgh there was a flour and cider mill; at Nankin a flour mill and still lower down, Coon's lumber mill. The Nankin mill was still grinding grist eight years ago, but except for that, to employ Mark Twain's observation in Roughing It, you could not have found a mill by a dam site. The raised banks, the ponds and willows of the old mill sites were relics of an earlier economy, long since decadent, when the countryside had lived on its own and when the farmers round about had brought their wheat to be ground by the flow of the neighboring stream; an economy that went to pieces as the railroads spanned the continent, opened up the great wheat lands, and ushered in the era of manufacturing cities and of milling centers to which wheat is carried laboriously by railroads to be as laboriously carried back as flour. What Henry Ford thinks of a disorderly river is not a circumstance to what he thinks of the railroad system of the country which eclipsed its rivers and canals, and then went cold.

Fifty years ago at Dearborn on the Rouge, was a two-story farmhouse on a two hundred and forty acre tract. A farmer, Irish born, of English stock, his wife of Dutch descent, and their five children lived on it. They were prosperous as Michigan farmers then went. There was a Starlight wood stove for heat, a parlor organ and a hanging oil-chandelier in the front room, rag rugs, a cruet, a crimper to pleat caps and the other utilities of an old-fashioned homestead. The barn was stoutly built, with a frame of hewn logs. In a carpenter shop hard by were an old two-cranked boring machine and other tools, meager enough, of the sort which after 5,000 years the wit of man had contrived to ease or help his muscles in struggling with the soil. The rise and spread of harvesting machinery came after the close of the Civil War, when the West had need to make good its depleted man power. Father and boys worked in the fields, tended the stock, carried their wheat to mill. The earliest recollection of the eldest boy is that "considering the results, there was too much work on the place." That is the way he "still thinks about farming." The house and barn stand today intact, with every furnishing as it was fifty years ago or with its duplicate painstakingly gathered by Henry Ford as a matter of sentiment. The Nankin mill with its water wheel and its huge timbers held in place by wooden pins, (epitome in a boy's imagination of a better day which would put the forces of nature at man's beck and call) has been cherished by him, renovated and equipped with a Ford built turbine at double the cost of new construction. But the farm and its manual



A floor of the Nankin mill, once white with flour siftings, where seventeen men now work on automatic machines making screws and carburetor parts.

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labor the boy chucked, setting off against his father's wishes, for Detroit and work in a machine shop; and since, the man to whom that boy was father has never lost his consuming desire to "lift farm drudgery off flesh and blood and lay it on steel and motors." All his interpreters seem to agree on this point. But he soon found that people were less interested in something that would do the work on the farms than in something that would travel the roads.

So at the start, with his gas engine achieved, he built speedsters in the aftermath of bicycle racing; next, he built pleasure cars in the early days when the automobile market was supposed to be limited to the rich; next, breaking with precedent, his competitors and his associates, he built Ford cars for common use, changing the habits of a generation; and, finally, he has built tractors, to bring power to the farm "for to" plow and to harvest, for to churn and cut wood and to draw water. He has thus at length worked his way back to his starting point, to his boyhood conviction that there "was too much hard hand labor on our own and all other farms of the time," to the revolutionary corollary of his later years that with power farming, factory workers and field workers could become interchangeable parts in a new rural economy.

And after the tractor, as before it, the water wheel.

FOR, fifty years ago, at Dearborn, below the flour mills, the cider mill and lumber mill of the old order, there was a first sketch of the new. Prophets, after the manner of archeologists, might have found the tracks of a boy in the mud, as he built his dam across a little feeder of the Rouge near the Ford house, backed up the creek until there was enough fall to run his water wheel, attached a rake handle as a shaft, set going his coffee grinder and brought down the wrath of a neighbor whose potato cellar he flooded.

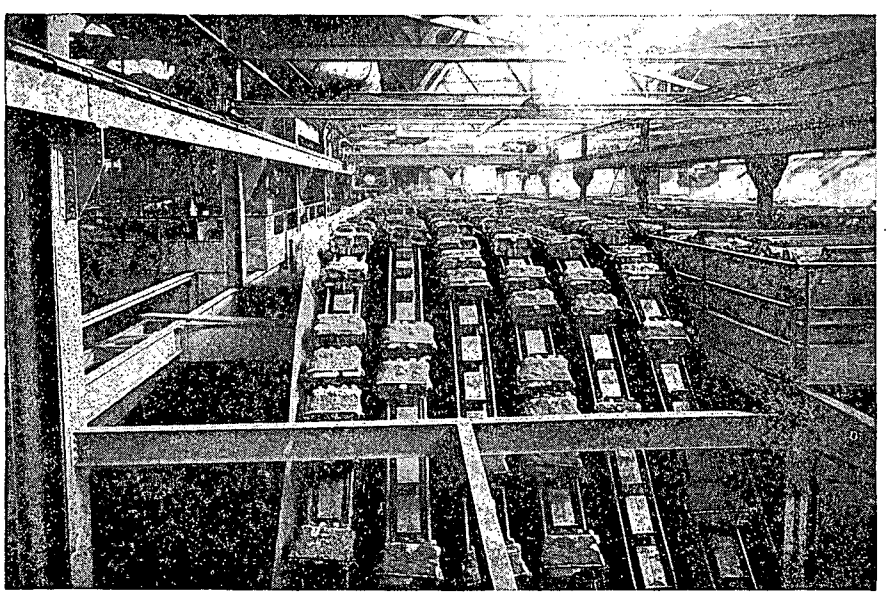
Today, on this small Michigan river, three miles up from its mouth, stand the stacks of the tremendous River Rouge works of the Ford Motor Company which has transferred to the Detroit suburbs a great chunk of Pittsburgh—blast furnaces, by-product ovens, foundries and the work that goes on with them. Further up the river there is Ford's own home at Dearborn, with Dam No. 1; and his pond stocked with fish. The horsepower he gets from it lights his residence and farm buildings, and runs his automatic telephone system. The 9,000 acres of his holdings encompass his father's old farm. He acquired hundreds of these acres for the purpose of trying out his tractor. Each year since (spending less than a month's time) he has plowed and harvested his fields with tractors and with factory-field hands drawn from the tractor plant itself. He grinds his own flour which he sells at cost to his employes, and turns over the wheat straw to be made into artificial wood for his steering wheels.

A refinement of the conveyor system in the village power-plant-factory at Phoenix., Mich. Yes, the girls get $6 a day.

Above Dearborn, the stream grows smaller, the current swifter and here and there on the old mill sites, some of them unused for a generation, Henry Ford is putting up new dams, modern turbines and small factory buildings. To these plants with their invitation to rural labor, he is transferring tiny departments from his main Highland Park factory (Detroit).

On the two floors of the old Nankin mills, once white with flour siftings and now as immaculate as an engine room, seventeen men work at automatic machines making screws and carbureter parts. A small modern plant, with the look of a power station, has taken the place of the Wilcox mill at Plymouth; and within, with twenty-five horsepower from the turbine, twenty-five highly skilled mechanics work at taps and dies. One hundred and fifty girls are employed at Phoenix, making generator cut-outs in a village factory above the spillway that seems as many-windowed as a greenhouse. At Northville three hundred and fifty men are employed temporarily in a renovated red brick planing mill, making valves for the Model T motor that goes into all Ford cars. At Waterford a new dam has been thrown across the valley which will give 280 horsepower; and the water rights and land of the old Beals, Newburgh and Coon's mill sites are in Ford's hands.

A scientist will work for years on what goes on in a test tube. Ford's test tube is a small water shed. This is his laboratory. He is putting millions in it, against the advice of some of his shrewdest



A multiple conveyor in one of the great Ford establishments which does the work of a caravan of men, wheelbarrows and trucks

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executives. He is experimenting on a scale which in some ways eclipses that of research institutions or governments. In another connection Marquis compares Ford to an acrobat with a net between him and the hard earth: "I suppose the fact that one has under him several hundred millions to fall back on renders him more or less indifferent to a tumble." The experiment is in its beginnings as yet. It may fizzle out, a rich man's plaything. But it may be that Ford is working at the sort of spark that may yet explode cities and get people back into the country, an invention as far-reaching in its influence as Ford car and tractor. He fooled with such things in his boyhood also and stuck to them as a man when they were called "crazy ideas." And whatever else may be said of Ford, he clings to a notion until he has squeezed its juice.

WHAT then is he driving at on his little river and why? I came off with some clues but also with the feeling that "neither he nor I nor nobody knew." Had he been a whittler in a village store, he could not have looked to have more time on his hands the morning of my interview, nor have given more taciturn replies to a stranger's queries as to trout streams in those parts. But in the next three days what he said became imbedded in a matrix of impressions from his workshops—from the stupendous Highland Park factory across the city, the great Rouge works down stream, the converted flour mill sites up-river—of things said in books by his interpreters, but more especially in parables of experience by men on the job—by a one-armed guide at Highland Park, and a young go-getter at the Rouge, by the production man who in sixty days' time got tractors off to England during the war; by an office man who showed me over the Ford houses at Dearborn, and by a young engineer on Mr. Ford's experimental staff who took me out to Nankin-Mills and Plymouth and had caught their gleam; by superintendents and foremen and men on the floor at Northville; by his fellow editor and by the rule-of-thumb country contractor who is building his dams after a fashion all their own. They were his manner of speech—his sign language, giving illustration and context to the thoughts he had thrown out in his fragmentary interview like a boy emptying his bag of marbles; half boastfully, half deprecatingly, but bashfully, keeping his secret as to which were the shooters among the peewees and clouds and agates. And so I shall fill in the chinks of that interview from these sources, although mosaics of this sort have the danger of imposing the writer's pattern; as Dean Marquis points out, throwing light on the inconsistencies of Ford's biographers and on the dissolving views from his own more sensitive impressions of five years at Ford's (when he left the ministry to take charge of the Welfare Department at Highland Park). "If only Henry Ford were properly assembled!" he exclaims, and finds an "inexplicable and ironical contradiction" in a "genius in the use of methods for the assembly of the parts of a machine," whose "mind has never been organized." This may well be the key to the contradiction between Ford's broad public policies and his racial asperity, his spontaneous generosity and the stories of convulsions within the Ford organization.

But it may be the key also to Ford's inveterate non-conformity; he takes hold of things from the inside but comes at them always with the fresh eyes of an outsider. As a youth on his father's farm he was a mechanic at heart, itching to be about his bent; thereafter he became a "sod-buster" in the machine shops and engine rooms of the city. He is a farmer, still, in the manufacturing business, with a farmer's notions of one-man control, his contempt for offices, charted organizations and titles. On the one hand, he violated all the inveterate customs of the shop crafts; on the other hand, he set the employers of Detroit by the ears by cutting his payroll loose from the old hitching-posts. The builder of the biggest factory and the biggest fortune of his time, he at sixty sets about shredding factories into scattered plants and challenges the centralization of wealth in the cities and the bankers' notions of capital.

And at sixty he turns back to village and countryside with his outlandish manufacturer's ideas of organizing for production, eliminating waste, distributing power, a very besom of insurgency against the scheme of farm life and labor he knew as a boy.

"ANY small part entering into a finished manufactured product," said Ford to me, "means a great deal of work. To make it in quantity calls for a lot of men. It is better to carry the part from the point where it can be made easiest and cheapest to the big plant where it is needed, than it is to transport the men."

Thus Ford, first of all as an urban manufacturer, explained why he favors the development of the small country factory as an economy and an easement to the transit and housing problems of the biggest congregate plant extant.

The principle is one upon which Ford acted when his management upset traditional machine shop practice. At the start of the Ford company a car was put together at a spot on the floor, and workmen brought to it the parts as they were needed in the same way that you build a house on a lot. The change came when they "began taking the work to the men instead of the men to the work." Until today, with tools and men in the sequence of the operation, with every part moving on work slides, overhead chains or moving platforms, all assembling is done in mechanically driven lines so that a man "shall never have to take more than one step, if possibly it can be avoided, and that no man need even stoop over."

In the Highland Park Plant are many-storied crane ways, as tall as the nave of a cathedral, with little landing stages at each floor, like the boxes in a theater, staggered so that materials can be lifted from the freight cars on the tracks beneath to the floors where they are needed. These landing stages, the cranes that lift the materials to them, the chutes that carry the finished products down to the assembly floor, bear the same relation to the 500 departments on the different floors of the Highland Park plant (each making or assembling a single part) as the sliding assembly lines bear to the men who work elbow to elbow.

But the principle is already beginning to unravel the skein it spun. To quote Ford (Crowther):

> When we began to make our own parts we practically took it for granted that . . . there was some special virtue in having a single roof over the manufacture of the entire car. We have now developed away from this. I hope that in the course of time the Highland Park plant will be doing only one or two things. The casting has already been taken away from it and has gone to the River Rouge plant. So now we are on the way back to where we started—except that instead of buying our parts on the outside, we are beginning to make them in our own factories on the outside. . . . This . . . means

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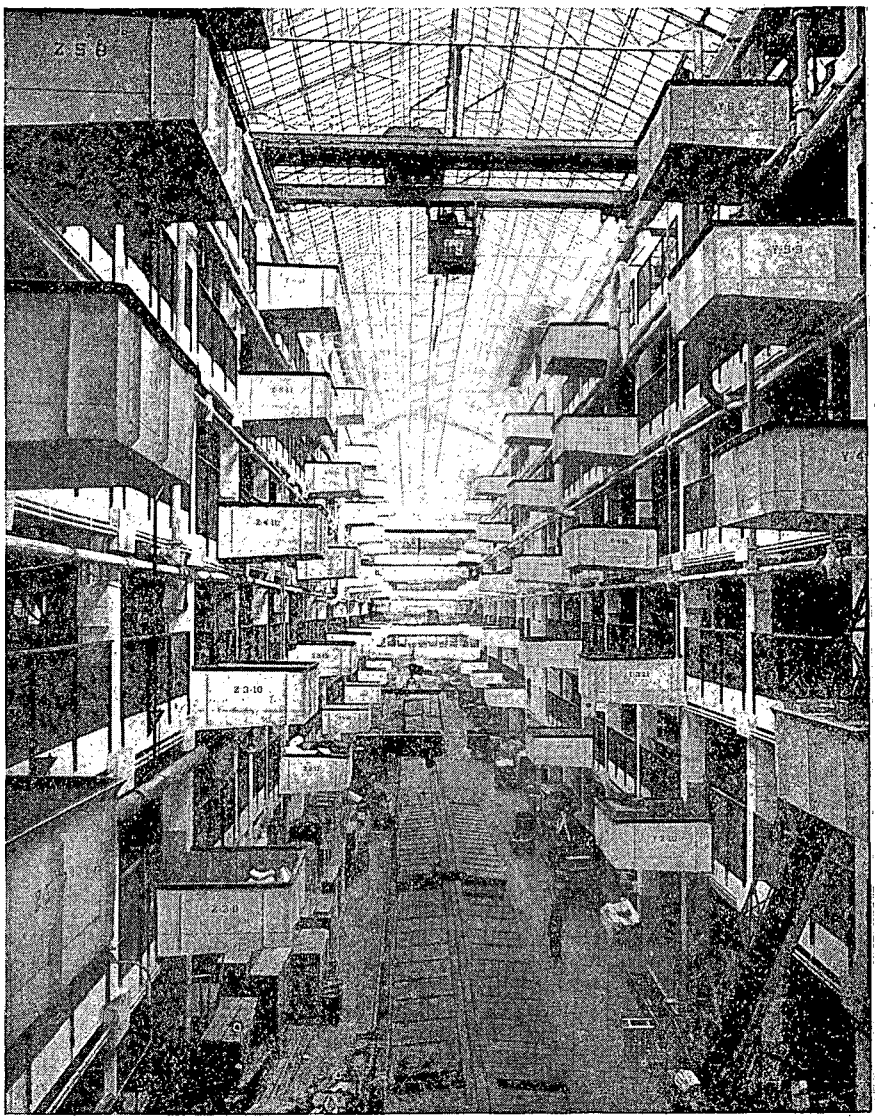
. . . that highly standardized, highly subdivided industry need no longer become concentrated in large plants. . . . A thousand or five hundred men ought to be enough in a single factory; then there would be no problem of transporting them to work or away from work, and there would be no slums or any of the other unnatural ways of living incident to the overcrowding that must take place if the workmen are to live within reasonable distances of a very large plant.

Here we have the setting of Ford's homely observation that it's "easier to carry the parts a man can make in a day than it is to carry him." He balances trucking 44,000,000 tiny valves in three years from Northville to Detroit against handling a 380-man department daily at Highland Park where they have to adjust the closing time of the shifts so that the men will not swamp exits, sidewalks, streets and transit lines. Here we have a prophecy of the quantity swarming to be looked for from that mother hive in Detroit should its 500 departments ever be scaled down to two. Eastern Michigan would become an apiary of small industrial towns. And here, with the navelike crane way at Highland Park as analogy, we catch a glimpse of the structure of Ford's watershed development.



The nave-like crane-way at his Highland Park manufacturing plant which Ford adapted from a German precedent; and which with its staggered balconies for receiving materials from the freight track below for the departments on the various floors, suggests to the mind's eye his scheme for distributing such departments in small industrial villages along a watershed.

"Take our case along the little Rouge [he said to me]. Fron. the mouth you can go clean through to the farthest point of China —or will be able to when they get the necessary dredging done. There are hundreds of such little streams running along through the land ready to give power. This one is going to give 1,000 horsepower and most of the people here in Detroit have never heard of it. You can place your power plants and small factories on the headwaters and your shipping point at the outlet. Our idea is to distribute plants around rather than distribute the power. Streams are better transmission lines than wires. There is a good deal more loss in wires. Water goes over a dam and is power still. We shall have nine dams on our little stream and still not get all there is in it. Damming up a stream does more than catch what is coming. The evaporization from the ponds makes the rainfall more even, and your power will grow with use.

People can live along the shores in villages with their farms fifteen miles away. That is where the Ford car comes in and makes for a new companionability in a country district. Last night I spent some time in Nankin Mills. It's a little place, only ten or eleven houses altogether. Some of the people that work at the plant painted their houses a year ago. Now they are all coming to paint and tidy up. One fellow who knew how, helped the others at the painting. There's splendid drinking water to be had from a big town near by. They are going to pipe it to the village—and not going to have to bond to do it.

There are only three or four dams the whole length of the Mississippi. There ought to be a hundred. Fifty years from now there will be a great many more small cities, rather than a few bigger ones. Instead of centralizing in one city there'll be ten cities. I talked to a man the other day who saw Detroit when it had only 14,000 people in it. The people of that day wouldn't have believed we'd ever have a million people here.

It's the same way about spreading out into small communities. I can't make any one else around the place see that the small power plant and the village factory will pay. In the same way, they could not see that it would pay to take the old engines apart when we bought the Detroit, Toledo and Ironton and rebuild them. But it has. Make them tidy and clean; keep things in general order and then look for results. It's the same way with the little village and the little plant. Put up a nice dam and a factory. Keep after the people, and the first thing you know, everything and everybody will be better.

At Northville we opened an old planing mill in 1920, and transferred the department out there that makes valves for the tractor and the car. Up to September they had turned out 44,000,000 pieces. We have 380 men employed there, two-thirds from the town itself; and the other third from the country round about. No one in the town is without a job. Traveling men tell us they wouldn't know the town for what it used to be. The grocers have fresh goods on their shelves and it's generally looking up. There is no labor turnover; and almost no overhead.

That mill, making small articles with automatic machinery, is always ahead so that when harvest and planting seasons come the men can be allowed off. And there has been a 50 per cent reduction in costs since the department moved there. The thing with a village plant or a tractor or anything else is to prove that it will do better work. That's the secret of Ford cars. People always see them running. The reason is that we make them exact.

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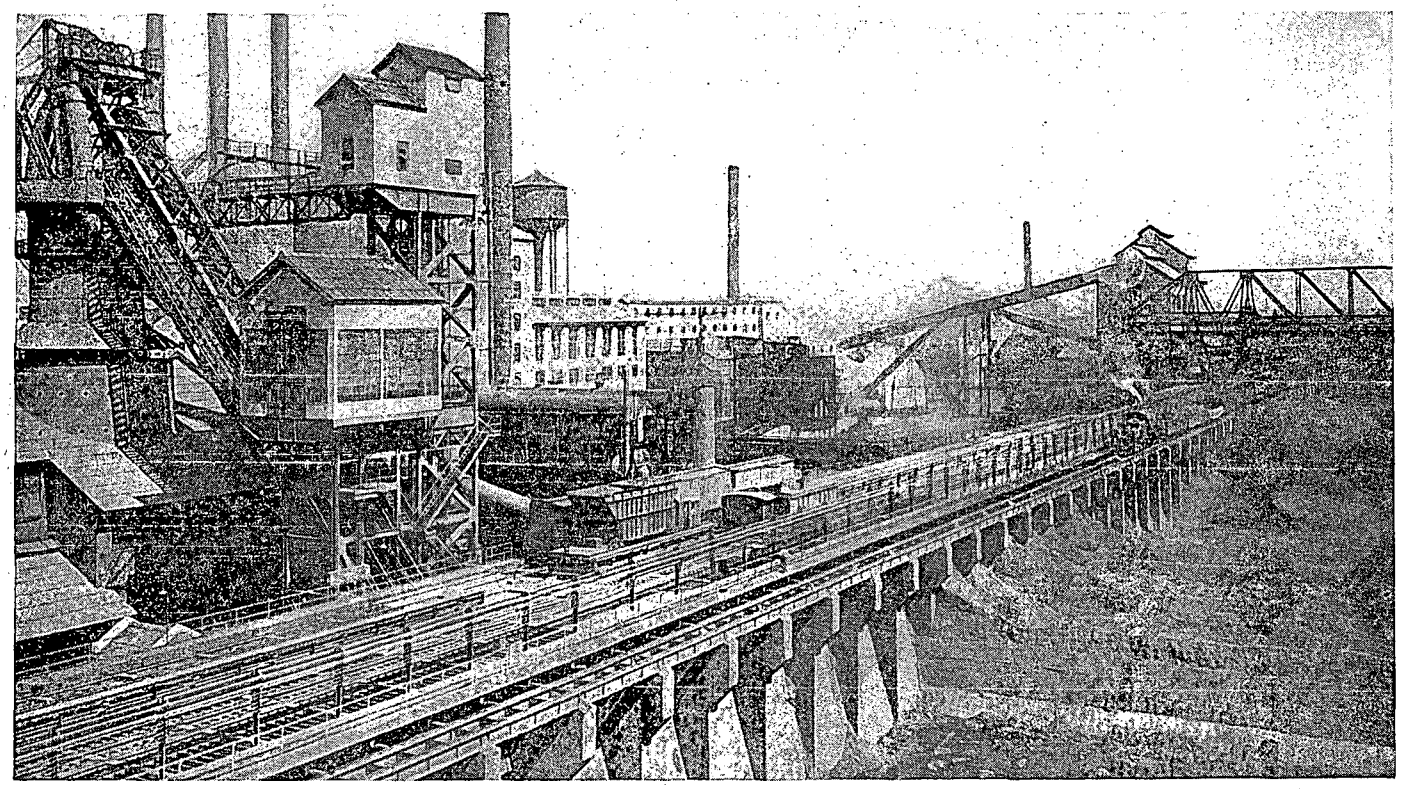
SO far as his own business goes, Ford is carrying out on a national and international scale some of the same principles he would apply in miniature to little watersheds like the Rouge. His concern for saving costs by saving time, space and waste effort, which begins with the needless shifting of a man's feet at an automatic machine, expands on the distribution side into setting up assembly branches in ten foreign countries, service branches in eight, assembly or service branches in thirty-four American cities. [No longer are a thousand freight cars packed with Fords in a single day in Detroit, five or six to a car; the parts are shipped at tremendous saving.] It expands on the production side to setting up specialized plants placed so as to secure advantages in handling raw materials, water power or water transit facilities.



Shipping terminal, power house, by-product plant, blast furnace and foundry, all interlocked in Ford's big new basic plant down stream on the Rouge. They integrate power and raw materials and serve today his great congregate factories where motor cars and tractors are manufactured and assembled—the last word in centralizing production in the automotive industry. Tomorrow, if Ford carries out his stated intention, they will serve a constellation of rural factories among which he proposes to scatter his manufacture of "parts"—decentralization of production on a scale hitherto unknown.

The first and largest is the Rouge plant itself, at a point on the Lakes which will match Gary and Cleveland as a meeting place for fuel and ore. He has taken over the down-at-the-heel Detroit, Toledo and Ironton Railroad and employs it at one and the same time as a feeder for fuel from his Appalachian coal lands and a spigot for his production, for in its 500 miles it cuts across half a dozen of the great east and west trunk lines of the country. This we are told has saved him six days on freight shipments, millions annually in freight charges, and released $24,000,000 of capital tied up in goods in transit. At the Rouge plant are his foundries, blast furnaces and by-product ovens through which he has cut down the cost of castings for car and tractor; here also is his tractor plant. To serve them he has bought the Banner Fork mines in Kentucky, with 10,000,000 tons of high volatile by-product coking coal, the Nuttalberg mine in West Virginia with 8,000,000 tons of low volatile smokeless coal (the two combined, it is estimated, will take care of his needs until he is eighty), the Imperial mine at Michigamme with 2,000,000 tons of iron ore, and 330,000 acres of timber lands in the Upper Peninsula of Michigan.

At Iron Mountain he is setting going an all the year around manufacturing operation in the lumber country. A great dam giving 5,000 hydro-electric horsepower will be used in conjunction with a big steam plant. He plans a wood-working establishment with an output at the start of frames for 150,000 sedan bodies and 600,000 touring car bodies; together with a distillation plant that will turn to account all the scrub lumber and limbs of trees and make the slash that ordinarily cumbers the ground after the lumber jacks have done their work, a thing of the past.

At Green Island (Troy, New York) with its water power and easy shipping on the Hudson, he is making axles, radiators, gears, drive shafts and universal joints; at Hamilton, Ohio, with 1,700 employes and a 3,000 horsepower hydro-electric plant he is making transmissions and wheels, getting the hickory for the spokes by easy shipment from Tennessee; at Glassmere (Penn.) his own glass. At Flat Rock, fifteen miles from Detroit, he is already using water power to make his lamps. Here he has built a dam, a railroad bridge for the D. T. & I. and a public road all in one construction. The dam gives hydro-electric power and sufficient water to float most of the raw materials to the plant. Set in the midst of a farming country, the site will also afford plots of ground or farms for the men—"a combination of agriculture and industrialism" with (*Continued on page* 658)

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EDITORIALS

THE relation electric utilities throughout the country bear to the communities they serve is brought home if we ask the question: What would happen if the millions of electrons should go on strike and electrical energy cease to flow? First, the lights would go out but that is not all. Electric traction would stop. Sixty per cent of the factory workers would be thrown out of work. The elevators in the office buildings would cease running. The newspapers would cease circulation. After a few hours the telephone and the telegraph would die from want of current. Where would the people go? Certainly not to the theatres. They would be dark and lifeless. They could go only to their homes and there experience the reminiscences of one hundred years ago by the light of a tallow candle.

So doing, their imaginations might conjure up both the hazards and the promise which the development of electrical power holds out in the next half century; towards which our present equipment bears somewhat the relation of a cruse of oil to the incandescent lamp. Even so we have no assurance that it will flood with light that twilight zone which reaches from Teapot Dome to the local hangout of the ward heeler and his job-hunting satellites. The filament of vigilance in this matter of lighting will be as necessary tomorrow as was the wick of yesterday. And in the matter of power, while the new high tension transmission affords opportunity for unleashing our cities, we should fool ourselves if we assumed that decentralization would be a self-winding process. Even the Niagara Falls district with its tremendous power resources hasn't panned out as its early real estate promoters anticipated; swift advances in the mechanisms of transmission gave it little advantage in power costs over Buffalo while the labor market, transportation facilities and other established advantages were all in favor of the big city. Electric power may pile cities higher than ever unless we make use of the opportunity it holds out.

THE chairman of the board of directors of a great American corporation recently remarked to some friends that one of the most difficult problems in our democracy arose out of the widening gap between the technical expert and the average voting citizen. This observation is especially pertinent in the field of electricity. It is illustrated by our popular habit of referring to such pioneers as Edison as "electrical wizards." Electricity is such a subtle commodity, at once so beneficient and so terrifyingly destructive, that we regard it and its high priests with a kind of awe.

As a matter of public education, we can come to regard the handling of electricity as scarcely more mysterious than the handling of the water that falls from the clouds, is gathered in reservoirs, and sent through pipes to our factories and homes. And it is to the advantage of society that all of us should have free access to the one as to the other. No force of nature which man has mastered can do so much as electricity to lift the burden of drudgery from the shoulders of mankind. "The sole salvation for the human race," writes Edwin E. Slosson in his Creative Chemistry, "lies in the removal of the primal curse, the sentence of hard labor for life that was imposed on man as he left Paradise." One clear road to that "sole salvation" lies through the widest possible distribution and use of electricity.

THAT we can, if we will, have electricity in abundance, the contributors to this number of Survey Graphic make clear. Yet hundreds of thousands of homes are without it, and other hundreds of thousands of homes can afford to use it for lighting only. Why should any American home be without it? Why should its price be so high that other homes cannot afford to use it for cooking, washing, sweeping and other domestic chores? Why should domestic users and farmers and craftsmen, who do creative work in their own shops, not have access to it on equal terms with the railroads and large industrial consumers? The progress of civilization demands that they should.

The average voting citizen does not need to possess recondite knowledge of the constitution of matter to ask and get answers to these questions. Unlike coal, the electrical industry in so far as it generates and distributes electrical current, is a legally established public utility under the supervision in most states of Public Service Commissions. If any family is unable to get electricity, it is the duty of these commissions to tell them why. If electricity is available, but the price is prohibitive, an explanation is due from the commissions. Why should the domestic rate per k.w. hour range from nine to fifteen cents in most American cities and towns when most towns and cities in Ontario get it for three cents and less?

About such questions there is no more mystery than there is about the supply and price of bread or beef. They are within the competence of all reasonably sane men and women. They are the practical bridge across the gap that separates the technical expert from the average voting citizen. Nothing that the layman can do will contribute more effectively to the rapid and socially advantageous development of the electrical industry as a public service than the persistent asking of these simple questions until they are satisfactorily answered.

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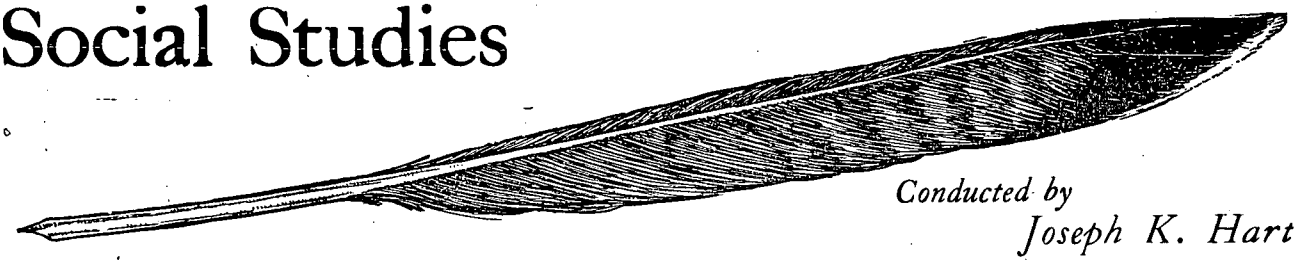
Social Studies



Conducted by
Joseph K. Hart

Power and the Group

HUMAN living began in small and isolated groups of primitive people. These primitive groups faced heavy odds in their gambles with fate—their struggles for existence. They were the legitimate prey of every marauding band of ferocious animals. They were under bondage to the vagaries of climate in the matter of their food supplies. They were in competition with many kinds of foes for the resources of their local territory.

Under such conditions, each such group either perished, leaving no record (except, perhaps, a stray bone in some ancient clay bank or cave); or it developed peculiar characteristics which fitted its members adequately, but narrowly and irrevocably, to the conditions of its existence. For the group, its own survival was the only important matter in the world: every act, emotion or thought within the group: every habit or custom of the group was directed to this one end, its own survival. No individual variation could be permitted; no super-group "internationalism" could be even faintly conceived. Around some bit of natural resource, a grove of cocoanut trees, a hunting range, a fishing station, a fertile field, the group organized its life, rooting itself in the soil, as it were, identifying itself with its possessions, and probably singing in primitive fear and frenzy the grand father of all national anthems. The group and its resources were one whole—not to be disentangled. "This is mine own, my native land!"

FICHTE, the philosopher, has shown conclusively enough that property has a psychological value before and beyond its economic significance. In accumulating property, in overcoming refractory things, men make real to themselves their own wills and build up the sense of their own importance in the world. For this reason, possession of property indicates the degree of control exercised by an individual or a group, and hence, the degree of importance of that individual or group in the community. An increase of property brings an increment of importance; a decrease of property a corresponding lessening of importance. A man without property is a man without importance; a man of property is a man of importance. These primitive feelings are so real to most of us that we have great difficulty in reconciling ourselves to any exception to these rules.

A man develops his will, a group develops its energies in accumulating resources and territory, just as a baby cuts its teeth on a bit of coral. The baby does not get its teeth from the coral; the man does not get his will from things; a group does not get its energies from its territory. But the external objects are necessary to the development of the internal powers. Each seeks the external thing, not for its own sake, but for its use in making real the internal power. Hence, when a group fights for increased territory, it may not be fighting for an economic enrichment at all; but for an expansion of its own moral being, an enlargement of its sense of importance. The economic increment may be purely a by-product of this inner urge.

FROM this point of view we can understand that the real resources of the world are the energies of men. All the resources of nature are but shadowy unrealities, until men need them, uncover them, release them, mold them to human uses, impress them with human shapes, making them instruments of man's life. The first hammer was a man's fist; the second, an enlarged fist, a stone; the last, is Vulcan's fist—the steam trip. The world is man projected.

THE history of groups flows from these released energies. A group can live in the coconut grove until its taste for nuts is satiated. Then unsuspected hungers are felt. New lands call to adventure and conquest. The super-group emerges because man has hungers and energies too great for the coconut grove. His hungers may destroy him or lure him to disillusionment. But he will find no peace until he finds his satisfactions.

But always shadows follow where he goes, whether in groups or alone—shadows of fear: fear of life, fear of the world, fear of the gods, fear of the things in which he finds most satisfaction. He has hungers that he dare not deny, yet for the satisfaction of which he may have to walk in fear the rest of his day. Ajax will defy the lightning, but Zeus will fall upon him with a thunderbolt. Prometheus will invade the heavens to find the gift of fire for man, but the gods will shortly chain him to the rocks and set a vulture to gnaw forever on his liver. Man will be bravely the image of himself in great moments: the next moment he may become the image of fear.

Then in some moment of defeat, the parts interchange: the substance dissipates into shadows and shadows take on the forms of reality. The materials out of which man made his first world, on which he cut his teeth and realized his will, turn into a pre-existent universe of whirling worlds and illimitable spaces, from which the gods are exiled, within which man is a speck of cosmic dust whose unimportance no contempt can measure. Materials become master. A bit of iron takes on a form which even the gods may not defy; as it was written: "And Jehovah was with Judah; and he drove out the inhabitants of the hill country; but he could not drive out the inhabitants of the valley because they had chariots of iron!"

Man forges his tools; in the flames of the forge he sees fantastic figures, ogres, giants. Beat his iron as he will, he cannot beat those figures out of it. His machines are but earth-materials cunningly wrought, through which earth-energies disport themselves in ways that profit him. Yet the finished machine is a fascinating, powerful, fearsome giant, before whom he stands perplexed: Shall he work for the giant, or shall the giant obey its maker?

AND with that grave doubt deeply troubling him, man, the individual, and man, the member of the group, stands today before the last and greatest giant of them all—Giant Power!

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Our Social Institutions

A Course for High Schools

XII. Democracy in America

When one man—a king, for example—is responsible for government and the welfare of the people, he is the only person who needs to know what is going on in the nation. But when everyone bears some share of this responsibility, then everyone ought to be informed, intelligent.

In New England, in the early days, the "Town Meeting" offered the chance to everyone: the people were first informed about the conditions of affairs; they discussed these conditions, pro and con; they voted to continue, change or discontinue them, as they saw fit.

America can scarcely have a general "town meeting": one hundred million people could not get into the hall. How then shall America be informed, intelligent? And how shall America know what is going on in the nation? Evidently, many things are happening—by secret maneuver. Some of these happenings are of sinister import. But there are many other things happening, in the open, about which we are only casually informed. This issue of Survey Graphic is an attempt to lay one of these great happenings before the people. What is the meaning of "giant power" for our democratic institutions and ideals?

1. Centralization of Power

The tendency of governments, through all the ages, has been toward complete centralization of power in the hands of a small group. Who was the leader of this type of program in the period of the founding of our government? What was his program? What were his arguments? Who was his chief opponent? What was the opposition program? What were the arguments of the supporters of this program? Which program prevailed? Does that old struggle still continue? Who are the supporters of the doctrine of centralization, today? Who are the supporters, if any, of the opposed doctrine? Which way is America moving, today: toward greater centralization of power, or toward greater freedom for the individual?

2. Centralizing Forces in American Life

America is a widely varied land, with coastal areas, mountain sections, and a great central valley. How have these scattered parts of the country been kept united within a common national life? What part have the railroads played in this? The telegraph? Newspapers and magazines? Books? Travel? Has America been too much centralized at any time? What industries have we which can be called "national"? What effects do these national industries produce upon our national life? Has any of these national industries ever tried to control the policy of the nation? Has any of them ever tried to capture the government? Has any of them ever succeeded in this effort?

3. Decentralizing Forces in American Life

How do the people of the Atlantic Coast areas differ from the people of the Pacific Coast? Are there any differences in their industries? In their institutions? How do these differ from those of the mountain areas? From those of the central valley? What industries have we which are truly local in character? What are the relations of these local industries to national industries?

What effects will the development of giant power systems have upon the development of democracy in America: shall we become more centralized and less democratic? Or shall we become more completely decentralized and more democratic?

References:

Texts in American History and this issue Survey Graphic.

Questions on Current Issues

Can It Be Done?

Once upon a time, men were modest, even reverential, in the presence of the universe. "When I consider thy heavens, the work of thy fingers," said an ancient poet, "The moon and the stars which thou hast ordained, what is man?" But the modern age has turned the tables. When Bacon wrote "Knowledge is power," though he wrote but a half-truth, he changed the current of human thought and turned the world of human conduct up-side-down. To investigate, to understand, at least tentatively, to control, to be able to predict and, therefore, to be able to organize the world on lines that promise more of comfort, more of convenience, more of leisure and, maybe, more of culture and beauty—these are some of the outcomes of the discovery that knowledge is power.

Now, no barrier stands between the investigator and the universe except his own inadequacy. He deals with all things with a nonchalance which only Zeus could have equalled in the old days. The old story tells us that after Adam and Eve had eaten of the fruit of the tree of knowledge, "Jehovah God said, 'Behold the man is become as one of us!'" Is that the secret? Has man, following the clue of knowledge, eating of the fruit of the tree of knowledge, developed such Power that he has become a god? If so, what is he going to do with his Power and with Himself? The sources of power have been but partially explored: within the atom are reservoirs of power so enormous as to bring a bit of fear even to the scientist who now is seeking to unlock those resources. With such unlimited resources in the universe, what may not man become,—what may he not make of his life: what comforts, what conveniences, what leisure, what culture and what beauty may he not realize?

1. The Limits of Man's Mind

Philosophers once divided the universe into two realms, the Knowable and the Unknowable. Does that distinction still hold? Does science, today, accept any part of the universe as impenetrable to ultimate investigation? What has become of man's former fears of the Unknown? Is scientific inquiry irreverent? Is there any danger in it? Are there any limits to the extent to which man may make the world over? Do the "blind forces of nature" ever resent man's persistent efforts to find them out? Is "Giant Power" a proper area for the employment of man's thinking and reconstructive efforts?

2. The Limits of Man's Courage

Some world-leaders fear that our knowledge is getting ahead of our moral control. In Mrs. Shelley's novel, Frankenstein made a monster that destroyed its creator. Is Giant Power likely to turn upon us in any such destructive way? What are the dangers here? If the secret of the energies locked in the atom is discovered, the discoverer will have power to wipe out the race in a moment and destroy the earth: should any investigator be permitted to secure such power? If monopoly control of our giant power systems falls into private hands whether of stockholders or power-workers, the people of America might be held as in a vise: should any economic group be permitted to secure such power?

Science is developing the knowledge by means of which the secrets of the universe will be unlocked: how much courage has humanity? Enough to enable us to become masters, not alone of the knowledge, but also of the powers unlocked by knowledge?

References:

All the materials in this number of Survey Graphic.

The books mentioned above may be obtained through The Survey Book Department.

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PANDORA'S BOX

(*Continued from page 560*)

power station goes principally to hundreds of mines and manufacturing establishments; the villages and farms through which the high tension transmission towers march in Indian file, bearing the thunderbolt captive on their shoulders, are still bleak with the traditional bleakness of the coal communities. Nowhere in America today, outside of Ontario and parts of California, can one find evidence of social awareness of the new technical revolution; nowhere are the social workers walking in step with the far-visioned mechanical engineers.

FOR the mechanical engineers are far-visioned. They are dreamers of dreams. Most of the great inventions upon which the possibility of Giant Power rests were only recently litlte points of light in the groping imaginations of men whom even their professional colleagues regarded as impractical visionaries, as they once regarded Langley, inventor of the aeroplane. But the mechanical engineers have developed a technique for the conversion of their dreams into realities. They have made dreaming pay and are no longer ashamed of it. They are no longer afraid of mistakes and abortive experiments because they know that it is only through the process of trial and error, guided by the logic of mathematical induction, that dreams can be brought into conjunction with their appropriate substantial embodiments. Invention and discovery in the field of mechanical engineering stand accepted among the recognized businesses and professions. But the social dreamers and experimenters have not forged their way through to a comparably independent status, largely because they have not achieved a comparably secure mastery of their technique. Mechanical engineers move from a working hypothesis to a specific development of the going technical structure; human engineers are apt to move from a dream of the good life into a luminous fog. But this disparity is disappearing. In the fields of sanitation and prevention health work, of workmen's compensation and safety, for example, the streams of consciousness made manifest in the mechanical engineering tradition and in the rising tradition of human engineering tend to coalesce.

We know that if we follow through on the lines of established scientific procedure we can master disease, can make men's bodies whole. Public health is the first of the neotechnic professions—a profession to which the welfare of the individual and of the group are synonymous, to which wealth and wellbeing are complimentary objectives. We are slowly acquiring a technique of mental health; slowly getting at the laws of cross-fertilization and heredity. If we are to avoid the social stumbling of our Eighteenth century fathers in the development of the steam revolution, we shall have to extend the technique of social control, to the whole range of social and educational problems involved in city, town and regional planning. As confident coequals with the mechanical engineer, the financier and the business promoter, the human engineers, promoters of human wellbeing, will have to dream dreams of the good life with specific reference to the calculable effects of the new technical revolution upon the existing social, industrial and economic structure—the present status of the farmer and wage earner of agricultural and industrial production and distribution, the comparative

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PANDORA'S BOX

(*Continued from page* 646)

values of large cities, small cities, towns and farming counties as centers of spiritual liberation in the individual and the group.

MECHANICAL energy is the life blood of our modern civilization. Its volume, distribution and use, almost more than climate itself, condition the human environment. With mechanical contrivances, whether in industry or government, the human engineer as such is not primarily concerned. He is fundamentally concerned, however, with their predictable social consequences.

The issue upon which any effective alliance between the human and the technical engineer must inevitably center—the issue that emerges in most of the articles in this number—is whether in the development of giant electrical power primary consideration shall be given to the service of the home, the farm and small community, where neighborliness and fertile groupmindedness are possible, or the further intensified development of mass production in already crowded and slum-breeding areas. As Mr. Wells points out, the steam engine demands the concentration of machinery and workers within an area limited by the short range of the transmission belt. The individual craftsman, whether in the town or on the farm, cannot afford to own a steam plant of sufficient capacity to give him cheap power abundantly, and in convenient form. This fact has had a decisive influence not only upon the destruction of craftsmanship and the domestic arts, but on the transformation of homes into tenements, and that congestion of population which deprives children of normal opportunities for play and growth.

Under an effective alliance of the human with the mechanical engineers, Giant Power can be made to give to the farms and the small communities equal access with the metropolis to cheap mechanical energy in its most convenient form. Not by a frontal attack on the over-populated cities, but by carrying the conveniences and facilities of electricity to the small town and the open country, Giant Power promises to decentralize population and while conserving the advantages of machine production, to restore to the individual craftsman the opportunity for creative workmanship on an economic basis. It is highly significant that the Pennsylvania Giant Power Survey Board has made the service of the farm its first consideration, and that decentralization and the increasing attractiveness of the small town and farm have been conspicuous results of large scale electrical development in the Province of Ontario.

In the United States the new technical revolution is still dominated by the same acquisitive drive which dominated the Eighteenth century steam revolution. The mechanical engineers have been carrying their work forward; the human engineers have not got under their end of the load. The social sciences have yet to make themselves count.

Knowing in advance what is in Pandora's box, shall we let the lid be lifted—laissez-faire, let her rip—or shall we by taking counsel together, seek to win the nascent blessings of the new technical revolution without turning loose its potential plagues?

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Aaron Sapiro, the genius of the producers' cooperatives which have swept East from California, will tell the inside story of cotton and prunes and wheat and of the countrysides which grow them. His articles form a modern and amazing version of Jack and the Beanstalk.

Ira S. Wile, M.D., from his children's health class at Mt. Sinai Hospital, will write further revelations of the deep-lying factors in the relationship between children and this clumsy world.

Richard C. Cabot, M.D., the author of "What Men Live By," will discuss, with special reference to those who mix in other people's lives, that disturbing question, "Where and When to Lie."

Neva R. Deardorff has made a study of some of the rich orphanages and of the poor children who inhabit them, from the old one at Girard College to the newest of the new like Mooseheart and Hershey.

John Dewey will discuss the changing conceptions of freedom.

Bertrand Russell, the English philosopher, will take up in a brilliant article, "The Effect of Science on Social Institutions."

Francis Hackett will give us another character sketch on the League of Nations; a contrast to the monumental pillared front and secret ally entrances of the old diplomacy—an informal description of the "non-foreign office" at Geneva.

Henry Ford tells of his plans for village industries in this issue; how they are panning out up river on the Rouge will be appraised in the April Graphic.

Eleanor Rowland Wembridge will, in "Silk Stockings" and other sketches, give us engaging human definitions for the terms in a psychologist's dictionary.

Samuel McCune Lindsay will discuss the social planks and the political platform-makers of 1924 from his vantage ground of professor of social legislation at Columbia University.

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OUR FEDERAL POWER POLICY

(*Continued from page* 573)

function in public view and be supported by the consciousness that its doings are observed by the public and that its efforts to maintain public rights are understood and appreciated by good citizens everywhere.

THE Act should be supplemented, or rather complemented, by legislation in all the States. What is needed is not a parallel and rival system such as New York has set up, but an interlocking system. Pennsylvania, under Governor Pinchot, has created the first state system of this kind by an Act passed June 14, 1923 (No. 294). This regulates future state permits for dams to develop water power, or to store, cool, divert and use water for steam raising or steam condensation in the generation of electric energy for use in public service.

As to all such future permits the principles of the Federal Water Power Act are to be applied. If the waters concerned are under Federal jurisdiction the state permit will be contingent upon the permitee's obtaining a Federal license, the conditions of which may be enforced by the Commonwealth if and to the extent that the Federal Government is unable to enforce them (i. e. if New York should win its suit) or waives them (i. e. if the Henry Ford offer should be accepted as it stands and the same principles extended to other applicants for power sites).

If the waters concerned are not within the jurisdiction of the United States a maximum time limit of fifty years is fixed, with extensions and renewals until the capital prudently invested on the faith of the permit has been repaid by the Commonwealth or by a new permitee; and broad powers are given to enable the state to impose conditions like those in a Federal license.

IF the other states would secure for their people the full benefits of the new era they must legislate in a like spirit of cooperation. States must cooperate with each other and with the Federal Government. Long distance electric transmission has made state rivalries in this matter ridiculous, and dangerous. The Federal Water Power Act sets up higher and firmer safeguards of common right than any state has, or can, alone set up. It gives to the people of all the states, without price, every possible advantage and preference. Submission to the state water laws and corporation laws is its first requirement; submission to state control of security issues, rates and service, its last. It leaves wide open to each state the door of choice between public ownership and private ownership under public regulation. If the choice is for public ownership the state or city is preferred over all private applicants. If the choice is for private ownership the act affords a basis for state control ("net investment" or "prudent investment") which no state has been able to establish for itself. In short, the Federal Water Power Act is the best possible foundation for the legal and administrative reorganization that will be compelled by the impending electrical revolution.

GIFFORD PINCHOT said of Survey Graphic: "I know of no magazine more likely to make a man think or more helpful to his thinking." If this is your first issue of the Graphic and you would like to see more of it, you will find a handy order form on page 663.

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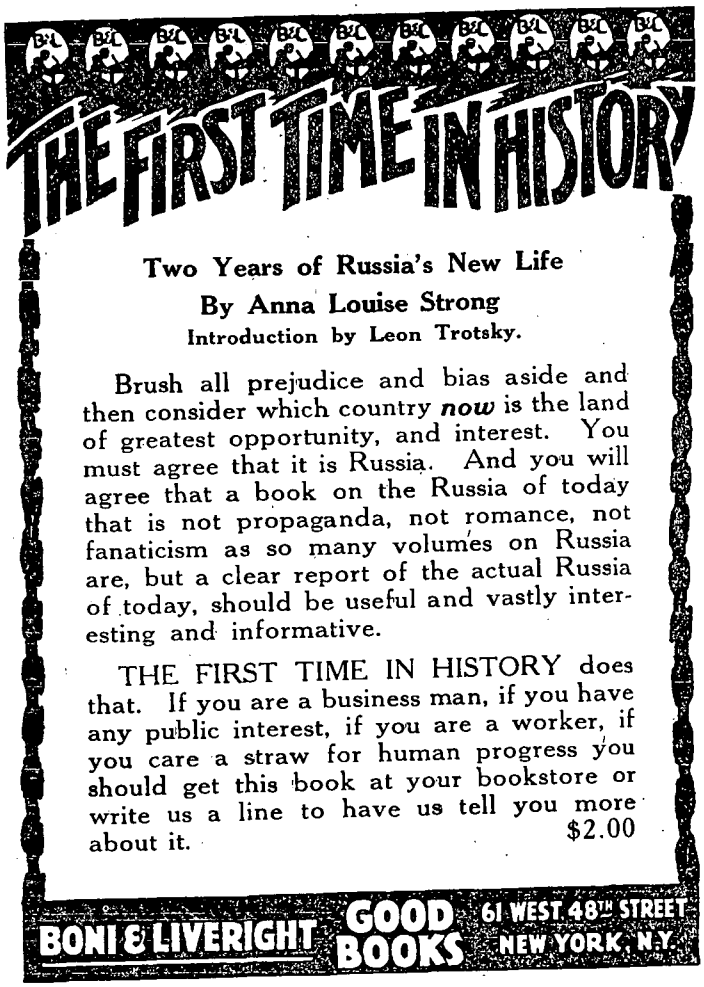
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ONTARIO'S EXPERIENCE

(*Continued from page* 590)

able provincial legislation, the low rental imposed upon bona fide developers of power, as well as many other factors contribute to facilitate the satisfactory utilization of provincial water powers for the development of new industries.

Power has been extensively used for the development of the pulp and paper industries; similarly, it has contributed to the success of mining operations such as are conducted in the Cobalt, Porcupine, Sudbury, and other districts of northern Ontario. Nickel, silver, gold, iron and other metals as well as many non-metallic minerals are known to exist over extensive areas in Ontario, and water power in the future will no doubt be requisitioned to an increasing extent in this connection.

THOSE who initiated the plan for the work of the Hydro-Electric Power Commission of Ontario were most particular to protect the operations of the Commssion from so-called "politics." That is to say, there was to be no political domination in the appointment of employes, in the purchase of supplies and equipment, or in other matters. It was recognized that such domination or interference inevitably tends towards inefficiency and mismanagement.

The success of the Hydro undertaking would have been impossible without the mutual respect and confidence which have existed among the various municipalities themselves, and between these municipalities and their Commission. On the part of all concerned, there has always been recognition of the solidarity of the interests involved and it is known that just so long as the necessary respect and confidence are maintained and political influences are eliminated, it will be impossible for any attacks to result in depriving the people of Ontario of the great advantages which they now enjoy as a result of their cooperative effort.

There has been a great deal of unfair opposition to the program of the municipalities in their hydro-electric undertaking, but criticism of the results obtained has come almost entirely from outside sources. Probably no public reform has experienced more misrepresentation than has the work of the Commission.

The many unjust attacks directed against the Commission have usually followed along a well-beaten track. They have consisted of grossly incorrect and misleading statements; the garbling of documentary and other data relating to the Commission's work and employing such garbled material as premises from which to derive conclusions. Pronouncements have been made based upon comparisons so inadequate as to be puerile; pertinent engineering data has been disregarded; comparisons have been made between unlike quantities and involving unlike conditions so that the comparisons drawn have been useless; considerations of engineering economics have been ignored; and erroneous statements have been made in a most dogmatic manner in the hope of imposing upon the credulity of those not having knowledge of the facts.

By such unjust processes, the work of the Commssion has been grossly misrepresented, but in spite of it all the work has prospered beyond all expectation.

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municipalities whose citizens know that their own "Hydro" enterprise is a great success—a success of which they are specially reminded every month as they pay their relatively small monthly bills for electrical power and light "at cost."

THE LONG LOOK AHEAD

(*Continued from page* 604)

SO much has been written as to the desirability of harnessing our water powers that the impression has been created that water power is necessarily not only cheaper but very much cheaper than power developed from coal. Niagara Falls provides an exceptionally dependable and therefore cheap water power. In round numbers it makes possible a cost of current including overhead at the station around 2 mills per kilowatt-hour. At modern plants in this country current made from coal costs from 5 to 6 mills in the same round figures. Philip Cabot says that with "the large companies (in New England) the cost of the current is not over five mills." So that the difference in cost between current derived from the best water power of which we know anything and that derived from steam driven generators is not more than three or four mills. Whatever the difference, it is sure to be much reduced by practicing economies which are clearly just ahead, such as by-product recovery and the widespread integration of the transmission and distribution systems with attendant cutting down of standby equipment and increase in diversity and load factors.

The student of electric rates will be surprised at their complexity and especially at the lack of uniformity in the tariffs of companies doing a comparable business. These and other aspects of the current system of electric rates will require study and standardization as essential features of any Giant Power program.

The electric industry was never more alive than it is today. It is probably as free from retarding tradition as any industry, and it is attracting to its service a personnel highly educated along technical lines. While it is becoming more and more subject to the inertia that goes with the unification of policy over wide areas, the incentive for experimentation and fluidity of practice are greater today than ever. On the adjustments of these opposing forces of inertia and progress the future of the industry appears to depend. The degree to which social vision is used in adjusting this conflict will largely determine the outcome of the decision as to public versus private ownership.

It is reasonably accurate to say that even the larger electric companies are not looking more than five years ahead in their construction programs; on the other hand, what the industry needs is at least a twenty-five year look ahead.

THE dash and vision which built the Panama Canal and gave New York City its Catskill water supply, might easily carry Giant Power to 90 per cent of Pennsylvania's population and at rates one-half of what they are today, and that within a decade, if the work could be put in charge of a non-political and a technically foot-free agency. There seems to be a realization that as the possibility of cheap power, widely distributed, and its meaning in modern life, are grasped, the public will demand the adjustment of those conflicting interests which now block the path to vital economies and the modernized electrical service to which the American people are entitled.

"I keep six honest, serving men;
(They taught me all I knew):
Their names are WHAT and WHY and WHEN,
and HOW and WHERE and WHO."

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WHEN was the pyramid of Cheops built?
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THE ENGINEER'S PLACE IN SOCIETY

(*Continued from page* 636)

the engineer has taken but little part. He has been very largely an academic adviser. He has not got down into the hurly-burly of the work to find the right solution, or how that problem should be handled to work out the best results. Yet it is an engineering problem. Here you have thousands of men engaged on work that is worth doing for the community, work that should win their respect, work that is constructive in every way, work that should appeal to the imagination; and still largely we regard it as a task to be performed! We eliminate from it all the individuality and the personality that must go with it if men are to retain their own respect and have ours. It seems to me that an engineer can introduce into that problem a tendency to a correct solution which is something that is very much needed.

And here is another thing. The wages that are paid to working men are an indication of the civilization of a country. There is nothing inconsistent between high wages and low costs. Merely you must see to it that your high wages are more largely productive. That is a question for engineering and management. Engineering must be on a constant search for better methods of production, must work for the introduction of automatic machinery, introduction of labor-saving devices. It is constructive, and in the interest of society, to eliminate human labor and to replace it by machinery. Labor will admit that. Of course it sometimes works a hardship, in the transition stages, upon the labor immediately engaged; but as far as labor itself and society as a whole are concerned, there is not a doubt that if you can reduce human effort by the introduction of machinery, you have marked another milestone in the progress of human affairs.

To illustrate by some work that has been done on the incandescent lamp: subsequent to the invention of that came the necessity of applying engineering methods to the problem of production—the problem of utilizing those discoveries to best advantage. That has been accomplished by the introduction of automatic machinery. Almost within the last year that industry has been revolutionized, and now we are on the way towards getting a much greater output per operator with less effort, a much greater output per square foot of floor space, and a much greater output in number of lamps per thousand dollars of capital invested.

There is an example of the application of pure engineering, of pure common sense, to an industrial problem. It has not been made by any one man; it has been made by a group of men working to solve that general problem. I used the lamp illustration because it is typical. It is going on in all industries. Wherever engineers are applying their minds to the problem of doing better work, where they are showing that decreased cost of production is not incompatible with increase of earnings to labor, they are helping in the general progress of humanity.

When this problem of establishing better relations between labor and management is solved, when men find greater pleasure in the work they do, and receive renumeration commensurate with the service they are rendering, the engineer will have performed his greatest service to society. The engineer's training has fitted him better for this task than the training given by any other profession.

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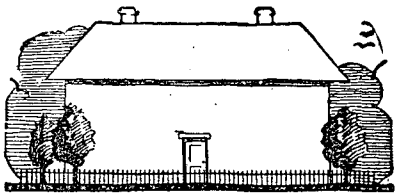

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The Animadversions of a Beginning Bookseller

RUSKIN may have been right; but, Ruskin or no Ruskin, I have started a circulating library. . . . Publishers are good souls, no doubt, in their fashion; but one can't help wishing, somehow, that each one might stop turning out his daily dozen of trash, and, instead, republish some of his worth-while out-of-prints. I wish I had taken Mr. Goldsmith's * advice and not gone in for new books at all,—it's too late to abandon the policy now, and I shall continue to carry the best of the latest; but still . . . It has been my sober observation that people do not *buy* new books,—with the exception of Yuletide, naturally. (Which hesitancy, incidentally, is no mean indication of their good sense—and taste.) They may *read* them,—but that's another matter. Department stores, and book-stores which are *book*-stores by the same courtesy that drug-stores are *drug*-stores, may afford the luxury of stocking them; *I* shall be chary. What with remainders, and cut prices, and shop-worn copies. . . . No,—I have started a circulating library.

But, even if bookselling has its drawbacks (like any other calling), and even if one is scarcely likely to accumulate millions at it, as my good friend Mr. Goldsmith ** has so justly pointed out, there are compensations. And not the least of these are the fascination of books (although one has not, as some ingenious souls imagine, the leisure to read all the "lovely" volumes on one's shelves; but, rather, one finds one's self reading less and less), and the contacts one makes. A bookseller can gather more interesting, if not exactly utilitarian, information within a week than another may in a year,—and all at first hand. Steel, rugs, ghosts, alchemy, glass, printing, conjuring, plays, calligraphy, philately,—these are just a few of the topics that come up almost daily. . . .

I must also say that the notion that "the public doesn't care for good books" is an erroneous one, as far as the Blue Faun is able to see. When new books are called for, I have found them to be, almost without exception, distinctly top-notch. And it is more than gratifying to see the old boys (so to speak) holding their own—and more. I have had, thus far, nary a call for H——d B—l W——t; on the other hand, scarcely a day passes by without De Quincey (say) being demanded.

Customers are, for the most part, rather interesting, once you come to know each one. It's my window display that "gets" them, so I gather,—it is rather clever, I think; *** several people have been kind enough to remark: "You know, your place is so different from the usual heartless department store affair!" For all of which the Blue Faun and I are duly grateful.

As far as the trade is concerned,—well, all in all, it has been rather tolerant. Mr. Goldsmith,† for instance, has been lavish not only with invaluable advice, but with actual, practical assistance. At the other extreme (but still not entirely uncordial), was the dean of the Fourth Avenue booksellers, who remarked that his interest in seeing a man putting his head in a noose, after having gone out of that head, was purely philosophical and untinged by any personal animus. . . . But, in the final analysis, I have found but three of the trade to be really good fellows and top-notch in every respect (if firms were persons, I might make the number four, by including Brentano's). The first is Alfred F. Goldsmith §; the second is a chap down on Fourth Avenue, whom I shan't, much to my regret, name, because I do not relish his partner; and the third,—but really, modesty forbids me to mention the third. . . .

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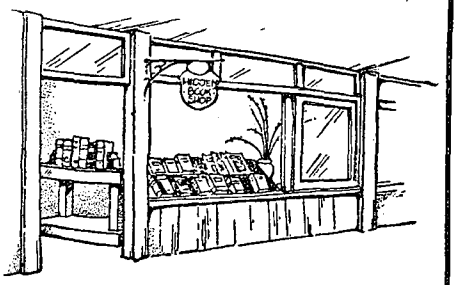

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IN THE SOUTHERN APPALACHIANS

(*Continued from page* 612)

reservoirs, which shall supply the power needs of the river as a whole. Plans are being made for transmission lines between the plants and for a central steam plant to supplement the water power when necessary.

On many of the streams of the South it is frequently necessary to install steam auxiliary plants. Their most effective use would be as central station plants so located as to be interconnected with hydro-electric systems. The economical installation of such auxiliary steam plants near coal mines is being given serious consideration in several sections of the South, especially in Virginia, Tennessee and Alabama. In North Carolina plans are being made for one in the Deep River coal fields.

In addition to storage facilities and central steam auxiliary plants, perhaps the largest increase in the efficiency of power development is to be looked for from the interchange of power between systems.

A striking instance was afforded in the fall of 1921 and 1922, when excessive drouths forced certain power companies in North Carolina to seek every available source of supply. Power companies in Alabama were the only ones that had any reserve capacity. The Alabama Power Company transmitted energy to the North Carolina companies, from them it went to the lines of the Georgia Railway & Power Company, which in turn furnished an equivalent amount of power to the lines of the Southern Power Company and they in turn furnished a similar amount to the Carolina Power & Light Company and The Yadkin River Power Company, in North Carolina. This interchange was over a distance of about 1,100 miles.

This brings us to a consideration of the broader possibilities of interchange of power, not only between adjacent systems but between systems that may be interconnected through other systems. A step in this direction is the lease of the Federal Government's steam plant at Sheffield, Ala., by the Alabama Power Company, Georgia Railway & Power Company, the Carolina Power & Light Company and a few other southern power companies. This makes the Sheffield plant with a total capacity of 90,000 hp. a central or cooperative auxiliary steam plant for the entire "southeastern zone."

Interchange is not yet possible for Tennessee, Virginia and West Virginia. Plans should be made for their interconnection, with central auxiliary steam plants near the coal mines. This will finally result in a superpower system.

While I believe that the development of an interconnected system on a national scale is undoubtedly fundamental to the future economic development of the country, I am still of the opinion that there will be first developed the interconnected and interchangeable systems of certain sections of the country such as the north and northeast; south and southeast, north middle west, and Pacific Coast. As these become more efficient and as interconnected systems and their transmission lines become more standardized as to voltage, they will gradually be linked up and in the end we will have the national interconnected system.

An important factor in water power development is the location of railroads. In the Southern Appalachian region railroad construction has too frequently followed lines which tend to hamper and prevent the very industrial development upon which the road itself must depend for its future traffic. Routes for new railroads or the relocation of existing railroads, should not unnecessarily interfere with the development of water power otherwise available for future industries in a newly opened territory. Even a higher location for a road bed at some excess cost of construction would be economy if it made possible power developments which would mean the settlement and enrichment of the territory in terms of freight and passengers.

But whether the railroads are finally placed in the mountain or Piedmont regions of the Southern Appalachian states, they will usually be near numerous undeveloped water power sites which should afford ample power to operate their lines at all seasons of the year.

Power development has already meant the creation of small industrial centers in the Southern Appalachian States. These have slowly drawn together largely from the farms the labor necessary to carry on these industries. With an increased amount of power available there will be new industries spring up that will need a new supply of labor. This labor will further strip the farms unless the farm home has been supplied with the conveniences and efficiencies that electrical power will provide.

Moreover, wherever such industries are established their economic operation depends largely on whether or not the mill or factory is surrounded by a stable population and whether there are cheap food-stuffs to be had in the vicinity. This will be assured only by making the farm-owned home as attractive as the mill-owned home. To have this stable population located near the mills on cultivatable land and to have the factory surrounded by well tilled farms is thus industrially desirable as well as important from the social and political aspect. These farms help the mill and the mill helps the farms. They reduce the labor turnover and keep down the cost of transportation of perishable food. It is axiomatic that the farm must become in time a plant as dependent on electric power as the factory.

Even in those cases where electricity has been brought to the southern farm, its use has practically been limited to replacing the kerosene lamp and the old-fashioned farm lantern. Little if any attempt is made to realize its economic value in the hundreds of ways which are open. These range from lighting hen coops so as to increase the waking hours of fowls to operating almost every imaginable appliance for farm work and household use. There is as yet a dearth of machinery built for operation by electricity under conditions surrounding rural life, and there is even less information reaching the farmer as to what electricity might do for him and its cost in comparison with the power of animals and men. Once his home is lighted, his feed ground, wheat threshed, corn shelled, hay baled, cows milked, hens encouraged, house cleaned, meals cooked, clothes washed by electricity, he will find himself able to cope with the labor question and to keep a home where his women will be content to live and his children to grow up and to carry on.

The picture I have attempted to draw is that of the Southern Appalachian States inhabited by a contented, prosperous people, grouped together in industrial and farming communities, a situation brought about by the economical and efficient development and utilization of water power.

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IDLE SLAVES IN THE SOUTH

(*Continued from page 614*)

light and happiness from the lives of unnumbered women and children—this is the sin and shame of our age.

It is costing the South dear.

At the 1919 figures, published by the National Bureau of Economic Research, the lowest per capita income in the United States, $364, is found in the East South Central states. The next lowest, $463, found in the South Atlantic states, is saved from being lower by the high incomes of Delaware, Maryland and the District of Columbia, which though included in these states, are not typical of the South. The third lowest per capita income, $491, is found in the West South Central states.

The results are inevitable.

The lowest, the next to the lowest, and the third to the lowest average incomes among persons gainfully employed in the United States are found in the South. The average incomes of her "gainfully employed" are less than a "living" wage for the laborer with a wife and three children in each of the geographical divisions named.

Hence the exodus of labor, white and black, from the South.

Both are deserting the farm for the city. They go seeking the means to live and better living conditions. Driving and drawing both is the unconscious quest for that which electricity, as nothing else, can give—greater productive power.

THEY drift by thousands into the Middle Atlantic and East North Central states—New York, Pennsylvania, New Jersey, Ohio, Indiana, Illinois, Michigan and Wisconsin—in which eight states, labor, equipped with 16,275,122 horsepower of power, produces almost five times as much of wealth, and receives approximately five times as much in wages, as labor, equipped with only 5,396,560 horsepower of power, produces and receives in the sixteen states and the District of Columbia, known as the South Atlantic, East South Central and West South Central states.

But an even more serious drift than that of labor from the South toward these eight states in the North has appeared. This is the drift of power.

Not only to grow industrially, but just to maintain the industrial development to which they have attained, the Middle Atlantic and East North Central states must find new sources of power for manufacturing purposes. Unlike the South, these states have not sufficient water power to operate the industries already established within their borders, even if they should develop all of their water powers.

They must today depend upon coal for millions of horsepower of power.

Of their nearby supply of coal, Frank G. Baum, in his "Atlas of U. S. A. Electric Power Industry" says:

I understand on good authority that the "Pittsburgh vein" of coal will be exhausted at present rate in about twenty-five years.

D. B. Rushmore, chief engineer in the power and mining department of the General Electric Company, it is said, calculates, that if our coal consumption were to continue to increase at the apparently normal rate of seven per cent each year, the life of our known reserves would be:

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WHEN the predicted day of the exhaustion of these fields does dawn, if other sources of power shall not have been discovered, Louis' *"Apres moi le deluge,"* and the grim realities which followed, will be merry jests in comparison with the struggle, which will inevitably follow, for power.

Therefore, the map of "the Super-power System" for the whole United States, which has appeared in the power atlas by Mr. F. G. Baum and in various newspapers of the country is of supreme interest to the South. [See page 608]

Ship charts marked the course travelled by those floating hells which sailed from harbors in the North to bring Negro slaves from far off Africa in answer to the call for labor to work the plantations of the South. Just so this map marks the route which capital proposes that the transmission lines shall travel and carry the slaves in our water powers in answer to the call for power.

The map should, and doubtless will, cause anything but comfortable thought to the South with her millions of slaves idle in her streams and rivers, her territories and people unserved, and those ever growing industrial centers in the North calling for more power.

Not a single proposed line on the map runs southwardly toward, or through the vast stretches of powerless country lying between the Appalachian mountain ranges and the South Atlantic Coast. A solitary line goes southwestwardly from Muscle Shoals in Alabama toward the Gulf.

But new transmission lines appear running north and northeasterly from Muscle Shoals, and connecting with other power lines running northwestwardly from the great waterpowers in the mountains and hills of West Virginia, Virginia, North and South Carolina, and Georgia—the section of the Union possessing the greatest water power resources east of the Rocky Mountains—all of the transmission lines converging in a net-work of lines covering Pennsylvania, Illinois, Indiana, Ohio and other northern states with their huge manufacturing centers.

Their call for power is greater and far more insistent than was the call which brought the Negro slaves to work the tobacco and cotton fields of the South. It would be strange, if this call in the North should take from the South not only the descendants of the Negro long ago freed, but also the slaves in the water powers of the South. The facts should be faced.

THERE is no incentive to capital to take the hazard of developing water power and constructing transmission lines to carry power through the thinly settled sections of the South, to build up these sections, so long as capital can skim the cream of the business in the Piedmont districts, and hoard, by holding them idle, the great bulk of the water powers of the South; capital fearing no competition, but calmly confident of controlling power development, and later reaping a golden harvest, both from the growing markets for power in the North and from the rising of more and richer cream through the gradual growth of sections like that of the Piedmont Plateau in the South.

So long as capital can follow this course, dwindling popula-

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tions, abandoned farms, and deserted villages may be expected in the powerless sections of the South, which should be, but are not, served with power from the power surplus in those districts rich in water power, at a time when cheap light and power are as essential as are good roads to the life and growth of any people.

Is this to continue?

The power corporations have neither recognized nor met the South's crying needs, so evident in her millions of lightless homes, her factories using steam instead of electricity, and in those great stretches of country without the sign of a power line.

In California, capital has followed a different course. [See page 605] This state has water power enough developed to operate every manufacturing plant in the state, operating at full capacity, day and night, and leave a surplus of 383,083 horsepower. More than 90 per cent of her homes use electricity. Her network of transmission lines, covering the state, carry 500,000 horsepower of power, equal in labor energy to 6,000,000 men, to her farms alone.

Here appears another drift out of the South, quite as ominous as the drift of labor and power to the North.

Prior to the Civil War, one of the great crops of Georgia was rice. Prior to 1912, the planting of rice was practically unknown in California. In 1918, the rice crop of Georgia was valued at $54,000. In 1919, the rice crop of California was valued at $27,000,000. This year, 1923, it has been reported, California has been able to undersell Japan in the rice markets of China. This has been made possible by the use of electricity on the farms of California.

It is not surprising that the highest average income among farmers in the United States is found in this state.

Notwithstanding the enormous sums already invested, millions upon millions of dollars to develop more water power are now pouring into California.

We are told that in ten years, all of the available water-power in California will have been developed. At the rate of past investment in the South, a century or more will be required to put her water powers to work.

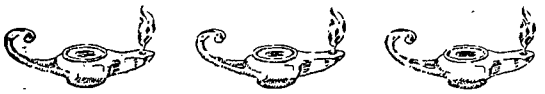
This difference must be attributed largely, if not wholly to the laws of California.

These make the hoarding of undeveloped water power impossible. Municipalities and counties have the authority to develop water power for themselves, and to organize public utility districts in order to unite their financial strength for this purpose.

CAPITAL, seeing the possibility of losing the field altogether for private development, pours into this state, as into no other.

And the Province of Ontario is also illuminating. [See page 584]

This Canadian state with a smaller population than that of Georgia, has developed, through the cooperation of state and municipalities, more water power than the combined development of the eight East South Central and West South Central states—almost, if not quite as much power as that developed throughout the South Atlantic states, stretching from Delaware to the southernmost tip of Florida, with a population of more than 13,000,000 people, only a comparatively small fraction of whom living to the southeast can get current from that much advertised "Superpower System" of the power companies.



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The laws of California and of Ontario, which have already produced superpower systems, not in name, but in fact, today actually supplying light and power to the great majority of their peoples, seem to point the way out of the powerless wilderness in which the majority of the people of the southern states are wandering.

Let the people of the South have such laws as those of California and Ontario, and give them the understanding of the possibility of multiplying the productiveness of labor by the use of electricity, and the strength of millions of men will leap to work.

Then the southern states, unafraid for the future of their children, because able to control the working force that has been given them by God, can take their rightful place in the development of a giant power system for the whole United States.

Will the call of the homes, industries and farms of the South be heard?

Not only the South, the World is suffering, striving, crying, if civilization is not dying, self slain in the struggle, for the want of increased production.

These idle slaves should be put to work.

THE PLAY OF A BIG MAN WITH A LITTLE RIVER

(*Continued from page* 642)

"the entire absence of the evils of concentration," as interesting in its way as his road-bridge-dam.

At St. Paul, the Ford Company has leased the new high dam, 574 feet long, with 34 feet head, and is tearing out the sub-structure to install four great vertical-runner-type water wheels which will be the power plant of an all-around Ford industrial center of the first class. Its general scheme was given me by a Ford man in this way: The rivers have been the basis of Twin City prosperity; a first epoch when lumber came down stream, a second, when the grain of the whole Northwest came to the flour mills. But the timber lands have long been cut over, low lake carriage to Buffalo and the East from Duluth has deflected grain shipments, and St. Paul and Minneapolis could not get together on a program to recover their position by exploiting the big government engineering project which set the high dam on a site between them and made the Mississippi navigable to St. Anthony Falls in the center of the state. Enter Ford, by invitation of both cities, an outsider with money, his highly polished formula and none of the rust of local animosities about him; harbinger of a third, a manufacturing epoch; with water, iron and wood ready to hand in Minnesota and Michigan to play with after his bent, with river carriage, a big urban population to draw on for labor, with a big agricultural population to sell to, and, above all, 18,000 horsepower to turn loose in his works. Then, with manufacture at the headwaters at St. Paul, with possibly manufacture at tide-water at New Orleans, with assembly and distribution at St. Louis to the great prairie states, the river his sluice way and his canal, we have a blue print of Ford's application to the Father of Waters itself of the ideas that he is fooling with in his laboratory watershed on the little Rouge.

FORD'S entrance upon water power falls in the third stage of his manufacturing operations—his entrance upon the "heavies"—which (witness the European conflict, now in its eighth year, over Alsace, Lorraine, the Saar and the Ruhr) are pivotal in the economic life of the world. His course runs from an inventor (1) to an assembler of motors and vehicles, (2) to a maker of parts, (3) to a producer of raw materials going into these parts. What he has done in invading the coal industry, iron and steel, lumber and railroads has been to play insurgently with great tools—with blast furnaces, railroads, mines, power plants; but also with all the Dutch thrift in him engaged, to go after by-products, and salvage on a magnificent scale.

His foundry was the stepping stone; he found it a place where wheelbarrows and shovels and back-muscles abounded; his old enemies of the farm; his molding is today done by machinery, and molds are made, cores packed, metal poured with the work in motion on the platforms. "They told us we could not cast gray iron by our endless chain method," says Ford, "but we are doing it." Back of the foundry is the blast furnace. Ore, limestone and coke are dumped into the top of the stack and after the heat, the molten iron is customarily drawn off at the bottom into pigs. "They told us," says Ford, "it was out of the question to pour the hot iron directly from the furnace into the mold," but the "Henry" furnace was blown in in 1919, and the molten iron run off into great ladles which travel into the foundry without another heating, as they do in a modern steel plant from blast furnace to Bessemer converter.

The blast furnace carried Ford into the coke market and into the mines; he needed coal also for his power plants in the Detroit district. Up to the time of the World War, the prevailing method of producing coke was to bake coal in the old beehive ovens which dot the bituminous fields, and which waste everything in the process but the coke. Today, by-product ovens have been more generally adopted by the steel industry, but steam-electric plants in the Pittsburgh district and elsewhere are still operated without them. This is anathema to Ford. He was quick to seize the Solvay idea and at the Rouge plant are two great batteries of by-product ovens, which consume 3,000 tons of coal a day, and give off 2,000 tons of coke for the blast furnaces (which is also sold to employes for their homes), 26,300,000 cubic feet of gas (which is piped to the Rouge and Highland Park plants for heat-treat purposes), 17,800 pounds of tar, 60,000 pounds of ammonium sulphate (which is used for fertilizer), 18,000 gallons of benzol (a motor fuel) and 4,500 gallons of refined light oil. He is also experimenting with a cheaper low-temperature method of getting coke and by-products out of coal and one which, it is said, will yield gasoline in lieu of benzol.

Nor is this all. By a change made in the cupola of the blast furnace, 100 tons of dust a day—such as in years gone by flew over the average steel town, to the despair of its housekeepers—is recaptured; while his slag, which was allowed to pile up in a small hill near the old time blast furnace, is, in line with modern practice, turned into cement in a cement plant on the place. More:

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Are you a micawber?

MEET an old friend—Mr. Wilkins Micawber! First introduced to you by Charles Dickens in "David Copperfield". Always procrastinating, always out of money, always "*waiting for something to turn up*". And yet such a good fellow in so many ways—devoted to his home, a loyal friend, the genial apostle of optimism.

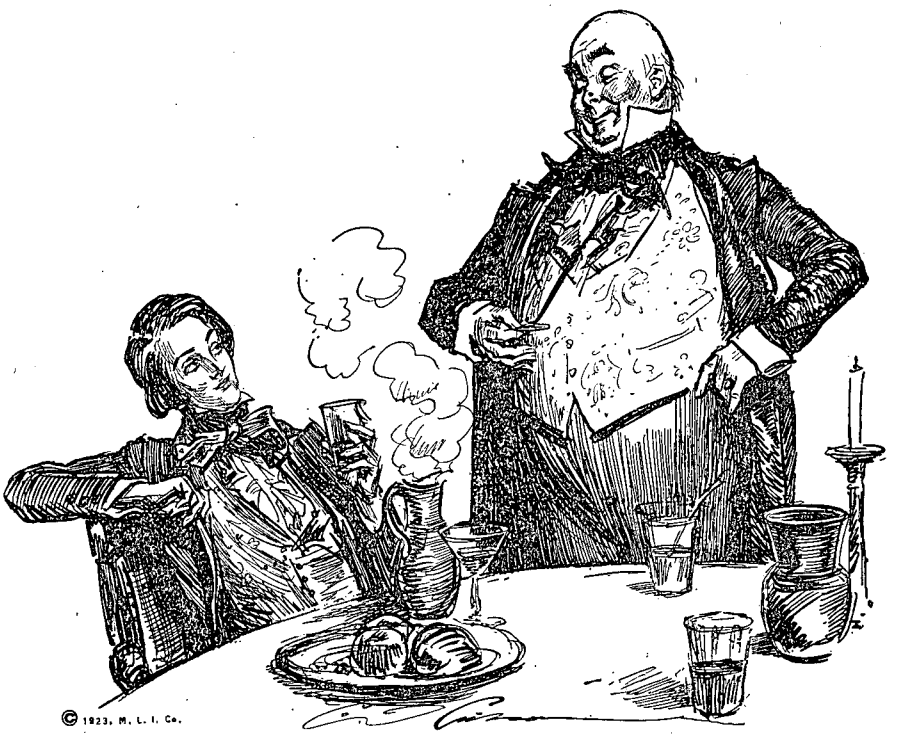
Nevertheless your sympathy went out to his trusting, never-deserting wife and their five children. And today you have only to look about you in every city, town and village—in every office, shop or factory—to see how this little family has multiplied thousands and millions of times. You meet its descendents everywhere.

A micawber is the person who spends every penny as fast as it is made (or borrowed), who lives in expectation of unearned success, who fools only himself in putting up a front. A micawber is the person who hasn't a penny in the bank, a share in the building and loan association, an interest in any benefit fund or a dollar's worth of life insurance. A micawber is a person who hasn't saved a cent.

"He's a regular micawber!" Could anything else describe to the dot the hopelessly hopeful person who never arrives at success because he never starts?

He's a micawber who, in spite of his need and his common-sense, will have nothing to do with living on the definite basis of a family budget.

CHARLES DICKENS put the word, *micawber*, into the English language seventy-five years ago. Straight-thinking economists put the word, *budget*, into it eighty-eight years before that. There was no reason why Mr. Micawber could not have lived on a budget basis; but he didn't want to — micawbers never do.

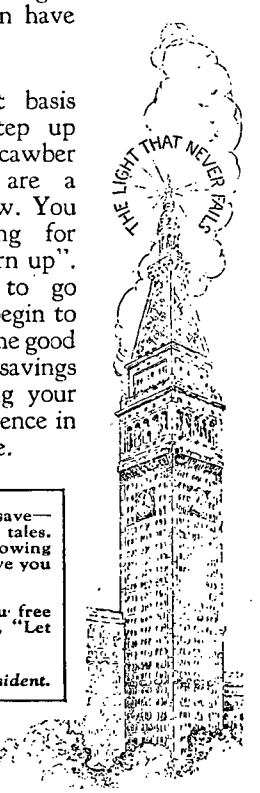


"My other piece of advice, Copperfield, you know. Annual income twenty pounds, annual expenditure, nineteen nineteen six, result happiness. Annual income twenty pounds, annual expenditure twenty pounds ought and six, result misery."

Micawbers prefer to spend what they have and wait for "something to turn up". No limitations of a budget for them! Yet the strange part of it is this: It isn't a *budget* that holds your scale of living down; it's your *income*. Think that over. In fact, budgeting your expense is a real incentive to increase your income, as well as the best way to get the very most out of what you have now. It tells you just where your money is going, *before it goes instead of afterwards*. The difference between budgeting and accounting is that one looks ahead while the other looks back. Which way do you wish to look?

The minute you begin to run your expenses on a real business basis, on a budget basis, you see just what you are doing. You see exactly how to reduce certain items in order to increase others that are more desirable. You begin to choose intelligently whether you would rather have one thing or another—for not one of us can have everything.

Get on a budget basis and you will step up and out of the micawber family—if you are a member of it now. You will stop waiting for "something to turn up". You will begin to go ahead. You will begin to get your share of the good things that only savings can buy, including your financial independence in the years to come.



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THE CHILD WELFARE LEAGUE OF AMERICA—C .C. Carstens, director. 130 E. 22d Street, New York City. A League of children's agencies to secure improved standards and methods in their various fields of work. It also cooperates with other children's agencies, cities, states, churches and other groups to work out worth-while results in phases of child welfare in which they are interested.

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INTERNATIONAL COMMITTEE OF YOUNG MEN'S CHRISTIAN ASSOCIATIONS—First appointed 1854, located New York City 1866, incorporated 1883. Headquarters office, 347 Madison Ave., New York City, N. Y. Tel. Vanderbilt 1200. Branch offices, Chicago, Atlanta, Denver. Chairman, James M. Speers; Treasurer, B. H. Fancher; General Sec'y, John R. Mott. The Committee maintains a staff of executive and traveling secretaries for service in the interests of the Young Men's Christian Associations at home and abroad.

JOINT COMMITTEE ON METHODS OF PREVENTING DELINQUENCY—Graham Romeyn Taylor, executive director, 50 East 42d Street, New York. To promote the adoption of sound methods in this field, with particular reference to psychiatric clinics, visiting teacher work, and training for these and similar services; to conduct related studies, education and publication; and to interpret the work of the Commonwealth Fund Program for the Prevention of Delinquency.

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NATIONAL CHILD LABOR COMMITTEE—Owen R. Lovejoy, sec'y; 1 East 104th Street, New York. Industrial, agricultural investigations. Works for improved laws and administration; children's codes. Studies health, schools, recreation, dependency, delinquency, etc. Annual membership, $2, $5, $10. $25 and $100; includes monthly bulletin, "The American Child."

NATIONAL CHILD WELFARE ASSOCIATION, INC.—Chas. F. Powlison, gen. sec'y; 70 Fifth Ave., New York. Originates and publishes exhibit material which visualizes the principles and conditions affecting the health, well being and education of children. Cooperates with educators, public health agencies, and all child welfare groups in community, city or state-wide service through exhibits, child welfare campaigns, etc.

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NATIONAL COMMITTEE FOR THE PREVENTION OF BLINDNESS—Lewis H. Carris, managing director; Mrs. Winifred Hathaway, secretary; 130 East 22nd St., New York. Objects: To furnish information, exhibits, lantern slides, lectures, personal service for local organizations and legislation, publish literature of movement—samples free, quantities at cost. Includes New York State Committee.

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NATIONAL ORGANIZATION FOR PUBLIC HEALTH NURSING—Member, National Health Council—Anne A. Stevens, R.N., director, 370 Seventh Avenue, New York. For development and standardization of public health nursing. Maintains library and educational service. Official Magazine, "Public Health Nurse."

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ROBERT W. BRUÈRE

Prepared for the Educational Committee, Commission on the Church and Social Service of the Federal Council of Churches

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Has it found us spiritually unprepared? Read this book and know for yourself the essential facts of our "bungling and inadequate use of a gift more magnificent than any allotted to man since grain was first sown to the harvest and ground at a mill." The author is Director of the Bureau of Industrial Research, New York City.

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BOOKS WITH A PURPOSE

The low volatile gases from the blast furnaces are piped to the power plant boilers, where they are joined by the sawdust and the shavings from the body plant and in addition the coke "breeze" (the dust in the making of coke) is now utilized for stoking. The steam power plant is thus fired almost exclusively from what would otherwise be waste products. Immense steam turbines directly coupled with dynamos transform this power into electricity and all of the machinery in the tractor and the body plants is run by individual motors from this electricity. In the course of time it is expected that there will be sufficient electricity to run practically the whole Highland Park plant and we shall then have cut out our coal bill." (My Life and Work: Ford. Crowther, p. 151.)

A contrast, if you will, to Ford's first power plant, fifty years ago and a few miles up stream, which he made with a rake handle and a coffee mill on his father's farm. A contrast, well nigh as great, to the typical factory that came down to us from the industrial revolution to the era of electricity, with its wasteful steam plant, and its maze of overhead belts and shaftings that carried power to the individual workman at his bench. A contrast intrinsically greater to the general run of work today on farms up the Rouge Valley that are as yet so largely untouched by power and untroubled by the genius of mass production.

IT will be seen that in taking over this part of his job from the archtype industrial city of America, this Dearborn farmer has added something to what he borrowed. The Rouge has been dredged at this point to 25 feet in depth; a large slip and turning basin are capable of accommodating any lake steamship.

A "high line" parallels it, 45 feet high and three-fourths of a mile long, carrying five miles of elevated railway tracks (five tracks abreast); all built so solidly that the twenty or more factory departments beneath them feel no vibration. A Mead-Morrison crane, 550 feet long, takes eight to ten tons at a bite from the cargoes of ore boats that are brought to the wharf side, and empties them into bins as big as city lots that store 12,000,000 tons of iron ore. Coal, coke, limestone are piled in other bins like the makings of a mountain. From the high line, your view of batteries of by-product ovens, the elevated tanks these feed, lofty breakers, blast furnace stacks, the great drab cylinders of their stoves and the white ones of the cement plant nearby, the ascending lines of chutes and overhead carriers, the flare of open ovens and the plume of steam from the coke showers, all give an impression of the buttressed walls and capped towers of an ancient castle, turned into steel and stormed by the investing magic of some latterday Merlin. You see a freight car run onto an elevated table, turned turtle, emptying its 50 tons at a heave. The next car bumps it down an incline and up an artificial hill. It stops of itself and runs back by gravity a quarter of a mile, self-switched onto a siding, all without a hand touching it. "Ford's touch," says the young fellow who is taking you around. You may add a pinch of salt to the tons of limestone and iron ore and coal that surround you, and set down for ardent discipleship the further confidence that whether it is the contrivance of a tilted side track or a revolution in furnace practice, the inventor himself ever and always has a finger in the pie. Very possibly they are the achievements of the organization rather than of the man. Mayhap there are fewer innovations at the Rouge plant than Ford fans imagine; precedents are to be found elsewhere in progressive practice; but here, they have been sought out and assembled in one major operation. The important thing is that these (*Continued on page* 664)

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Wanted by the DENVER SHELTERING HOME FOR JEWISH CHILDREN, of Denver, Colorado, a National Institution, an EXECUTIVE SECRETARY, must possess the following qualifications: Must be well educated in English and Yiddish, be a good speaker in both languages; must know how to procure, train, and handle solicitors; must make his residence in Denver, take charge of Denver Office, but be on the road organizing and advancing the work of our Institution at least six months of the year. Will pay reasonable salary. Give full particulars and send photograph with first letter or application. Communicate with N. Halpern, 401 Empire Building, Denver, Colorado.

BOYS' Camp (Jewish) undergoing reorganization would consider as partner man of refinement and education, who could act in capacity of head counselor. Location Massachusetts. About $8,000 required. 4733 SURVEY.

WANTED: Girls Club leader in an Eastern Settlement. Apply stating qualifications. 4710 SURVEY.

WANTED: Trained Public Health Nurses, salary $125. Give experience and reference. Visiting Nurse Association, 9 Market Street, Springfield, Mass.

MAN experienced in club and social settlement work. New York City position. 4727 SURVEY.

WANTED: In New York City, Jewish Case Work Supervisor, for a Family Welfare Agency, possessing general executive ability; also two experienced field workers. 4715 SURVEY.

WANTED: For child-caring institution, house mother of refinement and experience. Must be kind but firm disciplinarian. Children three to six. Position available April 15th. 4731 SURVEY.

WANTED: A Jewish Woman to fill position of executive case worker. One capable of taking full charge of organized work in North Western City. Must speak Yiddish. 4732 SURVEY.

DIETITIAN wanted to work as Visiting House Keeper with Family Welfare Bureau, Columbus, Georgia. Write, stating qualifications, experience, salary expected.

WORKERS WANTED

WANTED: Manager for tea room serving from two to three hundred people each afternoon. She must have domestic science training, successful experience and references, also initiative, executive ability, and a pleasing personality. Address Young Women's League, Dayton, Ohio.

WANTED: Cottage Mother for Orphanage near Erie, Penna. State experience, age, training and salary expected. Address Superintendent B'nai B'rith Orphanage, Fairview, Erie County, Penna.

WANTED: Two public health nurses with successful experience in pioneer field service. Salary $1800 and field expenses. Give training, experience and references. State Tuberculosis Association, Box 251, Charleston, West Virginia.

EXPERIENCED counselors for Junior boys' camp (Jewish). Give full details and salary expected. Location Massachusetts. 4734 SURVEY.

GRADUATE NURSES, dietitians, laboratory technicians for excellent hospital positions everywhere. Write for free book now. Aznoe's Central Registry for Nurses, 30 N. Mich. Ave., Chicago, Illinois.

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COOPERATIVE PLACEMENT SERVICE. Social workers, secretaries, superintendents, matrons, housekeepers, dietitians, cafeteria managers. The Richards Bureau, 68 Barnes Street, Providence, R. I.

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TEACHERS WANTED for colleges and universities. American College Bureau, Chicago Temple, Chicago; 1254 Amsterdam Ave., New York.

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FINANCIAL Secretary for Social Organization wishing to develop interest and support for its work. Young woman, ability, education, experience. 4724 SURVEY.

EXECUTIVE—young woman with considerable experience in child care wishes superintendency of small Jewish Orphanage. References. 4706 SURVEY.

SOCIAL WORKER, college graduate, eleven years' varied experience in children's aid work, city and rural, accustomed to public speaking, seeks responsible position. 4716 SURVEY.

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YOUNG MAN (single), experienced teacher, Settlement worker and Juvenile institution executive, desires a position with a progressive Child Caring Organization. Conversant in French, Italian and German. Best of credentials. 4725 SURVEY.

SITUATIONS WANTED

COLLEGE WOMAN, writer, speaker, understands publicity and is a successful organizer, wishes connection with social organization or publication. 4729 SURVEY.

EXECUTIVE (Jewish), many years' experience in Child Welfare Work in all its phases. Is of known reputation and standing. Would consider superintendency of Orphanage or Correctional School. Will be available May 1st. 4728 SURVEY.

EXECUTIVE position wanted as manager or steward of institution or hospital. Fourteen years' experience of institutional management. 4736 SURVEY.

HUSBAND and wife, college and social work training, 15 years' experience as executives, familiar with organizing, publicity, raising of funds, with special interest in community and delinquency problems in all aspects, successful writers and speakers, wish to develop or take charge of work. 4711 SURVEY.

CULTURED woman, American, no family ties, desires position as companion. No objection to traveling. Immediately available. Miss Foster, 120 Chestnut Street, Albany, New York.

WANTED: A position by young woman experienced in boys' work. Twenty years substitute helper, three and one-half years assistant teacher and assistant matron. 4737 SURVEY.

ORGANIZER and Executive, trained and experienced, ten years in one executive position in large city, desires job in social service as organizer or executive. Speaks several languages. Writes fluently. Speaks forcefully. 4738 SURVEY.

YOUNG WOMAN wants position after April 1st. Has had experience as recreation director, girls' worker and playground supervisor. 4740 SURVEY.

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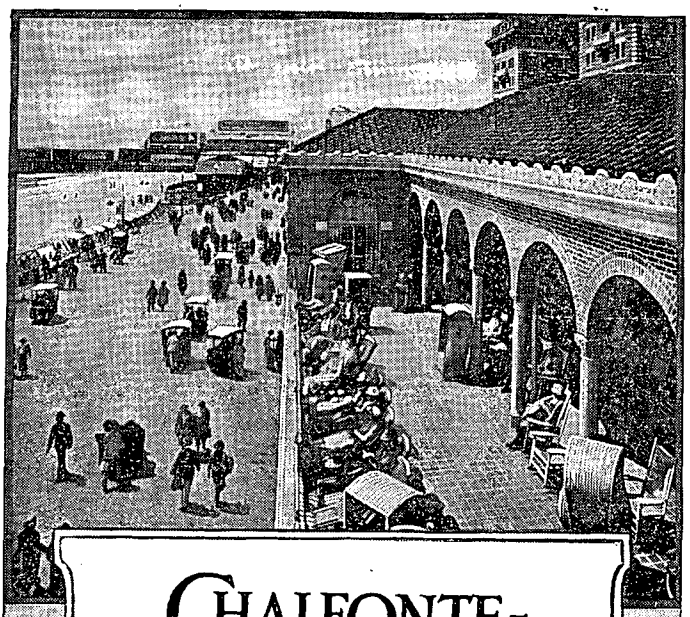

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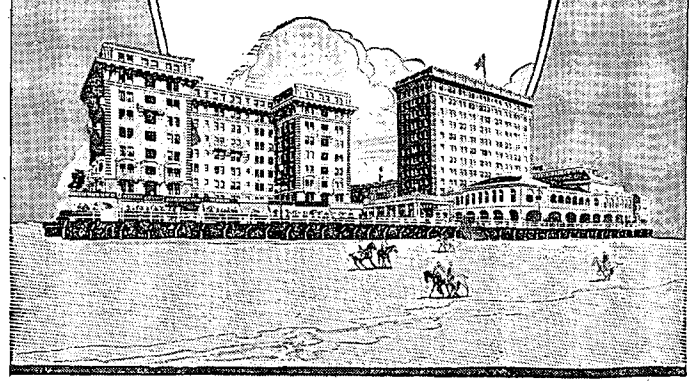

THE PLAY OF A BIG MAN WITH A LITTLE RIVER (*Cont. from page* 661)

changes, by whomsoever originated or carried out, are kin to the spirit with which Ford has approached the materials and forces in each of the great domains of industrial activity he has invaded, and which may be anticipated from him if he "goes through" in applying his ideas of power and production to country life itself.

DEAN MARQUIS' observation as to Ford's mind in the "knock down" may be the key to the fact that he probably does not start out on this last quest of his with any general theory of the social advantages of decentralization. He approaches rural water power development from several sides. He comes at it from the side of an inventor who spent nine years on a gas-engine and a car that would carry a load heavier, easier, faster and cheaper than a horse and wagon; who spent nineteen more years on a tractor that, like a cat, could pull out of all proportion to its weight. He comes at it from the side of a manufacturer, who has had a hand in making changes in two decades in the habits of industry which all but bear the same ration to the changes in the two centuries before that these last bore to the two thousand years that preceded the industrial revolution; who proposes to carry over some of this new division of labor from factory to farm. He comes at it from the side of a business man with cars and tractors to sell to 95 per cent of the people; who has cut down costs to the bone to get his product within their reach, and who sees that farms must keep pace with factories in organizing production and eliminating waste, if agriculture is to afford such a quantity market. He comes at it from the side of an engineer who would put power development at the service of the farmer, but sees that there must be new equilibriums in rural economy, in the balance between city and country, between factory work and farm work, if such an innovation is not going to disrupt everything around the lot.

My guess is that although Ford may not have a general philosophy of decentralization, we should find one deep seated inner impulse if we were to trace back his approach to rural power development from any of these various sides. That would be his boyhood captivation with the magic of a running stream, his belief in a djinn who might take over the chores of farmer and hired man if it could but be got out of the neck of a bottled creek, the hunch of a boy in a barnyard of what it would mean if natural energies could be domesticated as had the cattle of thousand hills.

(In a concluding instalment, "Up Stream on the Rouge," Mr. Ford will be quoted on what he calls "the most inefficient thing in the world"—the farmer living on the farm; and on his scheme for using factory workers for harvest crews, farm dwellers to operate small factories on rural mill sites. Superintendents, dam builders, foremen, $6-a-day-men, and others will be interviewed in an effort to gage how far he has got ahead in demonstrating his ideas in his valley laboratory, with his 9,000 acre farm at Dearborn and his little converted village planing mill at Northville which competes successfully for a share of his time with the great Rouge plant down river.)

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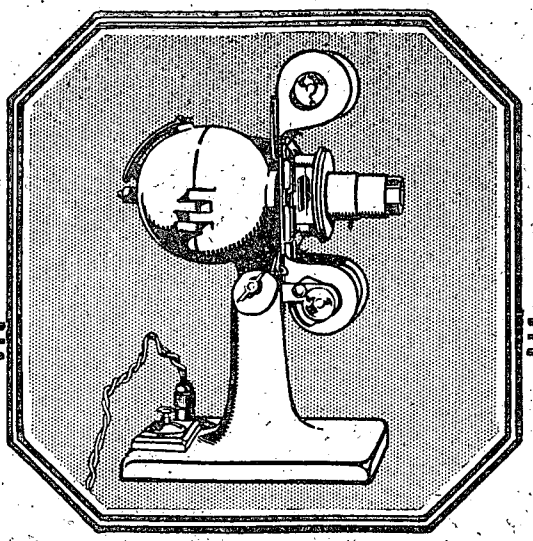

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